DESIGN, CONSTRUCTION, OPERATION OF METAL-WORKING AND ALLIED EQUIPMENT

MACHINERY

The unusual methods employed at the Oldsmobile plant in the production of front fenders will be the subject of the leading article in August MACHINERY. In this plant, 500 tons of dies are handled every night in changing over stamping presses so that fenders for three different car models can be produced without accumulating too large a stock ahead. Another article will describe the world's largest tool-room. Electrically cleaned air for operations requiring an absolutely dust-free atmosphere is another unusual subject to be covered next month.

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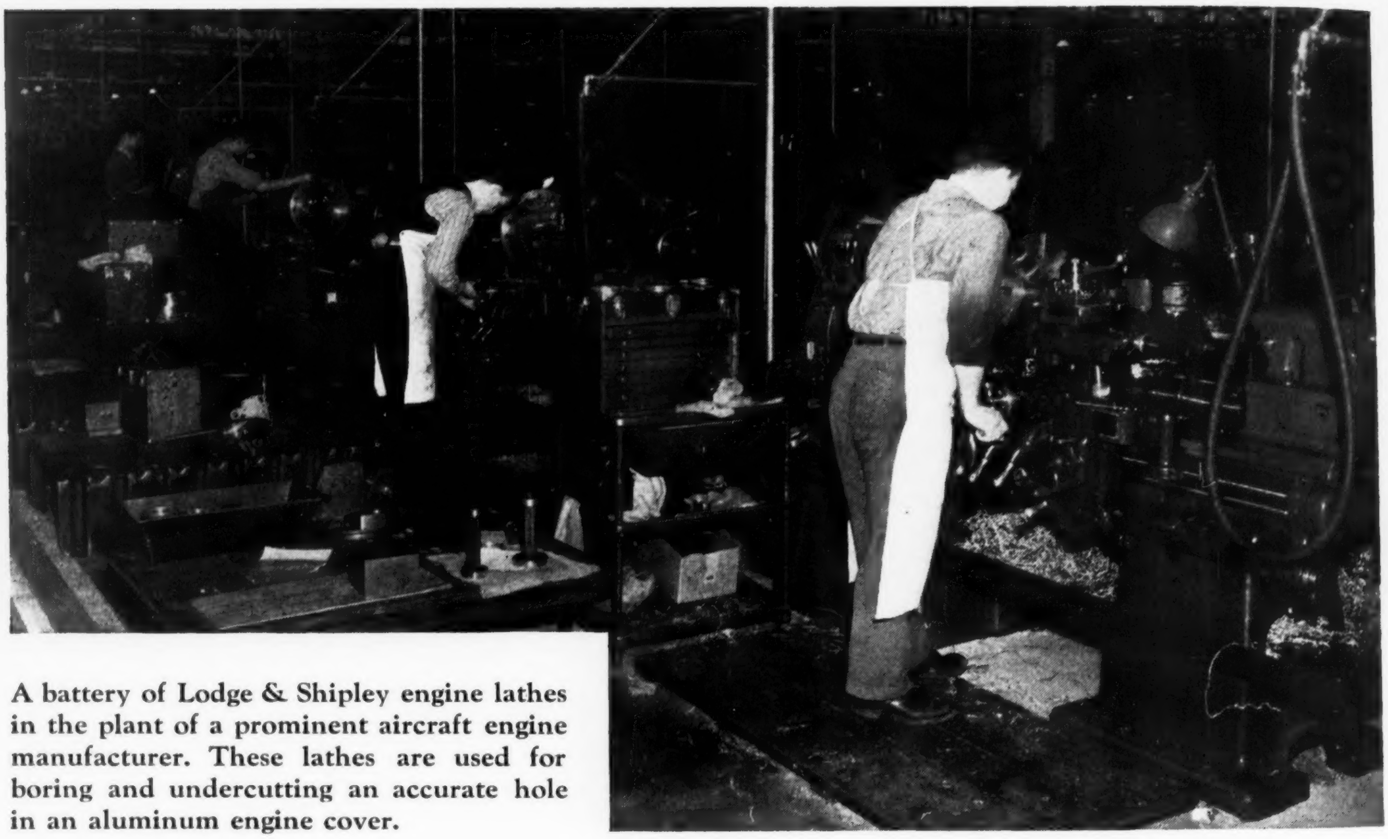
Fast

PRODUCTION OF PRECISION AIRCRAFT ENGINE PARTS

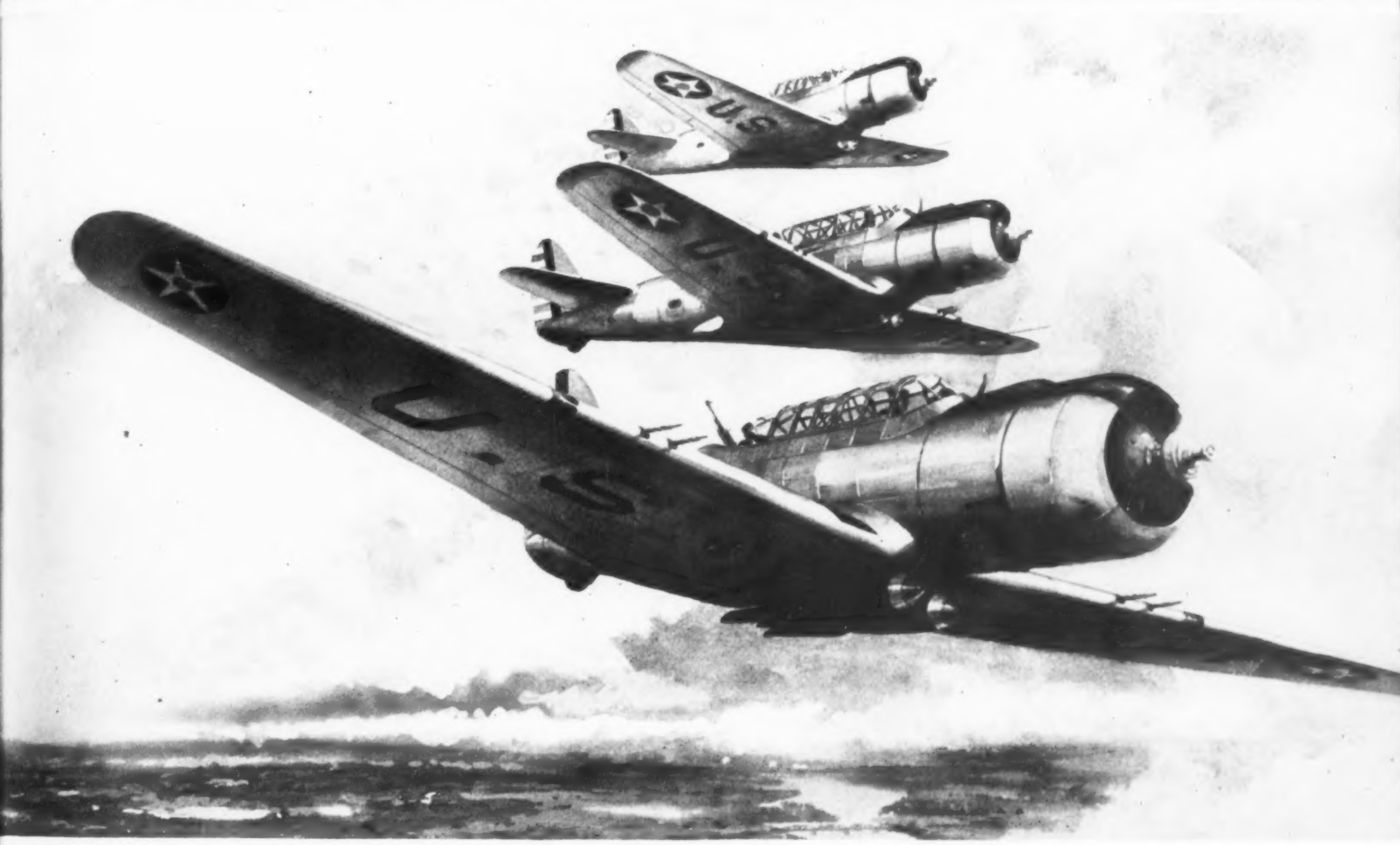


A battery of Lodge & Shipley engine lathes in the plant of a prominent aircraft engine manufacturer. These lathes are used for boring and undercutting an accurate hole in an aluminum engine cover.

Airplane cylinder turning on a No. 3A Duomatic. Above: Cylinder held internally at the Headstock end with a three segment air operated expanding arbor and supported at the Tailstock end by a three segment expanding center. Four diameters and a taper are turned by the front slide using a special tool block with a sliding holder and taper attachment combined. The rear tool block forms the groove and faces the three surfaces. Right: Two banks of tools used, one bank turning one surface of the fin while the second bank turns the other surface of the fin.

MACHINERY

Volume 46 NEW YORK, JULY, 1940 Number 11



America's Aircraft Industry Holds the Spotlight

THE eyes of the world are focussed on America's aircraft industry. Can it produce fighting planes rapidly enough to enable the French and British to attain supremacy in the air? Will it be capable of producing within a reasonable period of time the 50,000 military planes suggested by the President for national defense? Can these demands be met while the industry is also supplying the steadily increasing requirements for commercial planes?

Unparalleled progress has been made by this most vital industry since last autumn. Factories have been widely expanded in manufacturing equipment, floor area, and personnel. With the help of the builders of machine tools and other metal-working machinery, methods have been devised to produce planes, engines, and accessories in large quantities. This expansion will continue until the aircraft industry can meet all demands.

MACHINERY'S Third Annual Aircraft Number has been published because of today's world-wide interest in the American aircraft industry. The cooperation of the War Department and aircraft companies from coast to coast has made possible a comprehensive series of articles on the latest manufacturing processes of our fastest growing industry.

The Role of the Army Air Corps

By MAJOR GENERAL HENRY H. ARNOLD, Chief of the United States Army Air Corps

"OUR own vital interests are widespread. More than ever the protection of the whole American Hemisphere against invasion or control or domination by non-American nations has the united support of the twenty-one American republics, including the United States. More than ever this protection calls for ready-at-hand weapons capable of great mobility because of the potential speed of modern attack....

"With the amazing progress in the design of planes and engines, the airplane of a year ago is out of date now. It is too slow, it is improperly protected, it is too weak in gun power....

"From the point of view of our own defense, therefore, great additional production capacity is our principal air requisite....

"I believe that this Nation should plan at this time a program that would provide us with 50,000 military and naval planes."

These words were addressed to the people of the Americas by the President of the United States before a joint session of the Congress on May 16. At that time, the Air Corps of the United States Army was already operating on a plan expanding its pilot personnel to a strength of 4600 and its airplanes to 5500 by June 30, 1941.

The problem presented to the Air Corps by the President called for an expansion many times greater than the one upon which it was working. Let us see what will be necessary in order to meet these requirements.

The factors to be taken into consideration in the

in National Defense ★ ★

planning and development of a modern air force are multitudinous. The ideas developed and plans formulated one day must often be modified the following day in favor of something even more modern. The casualties resulting from a present-day "blitzkrieg" of the air are tremendous, but the casualties in ideas and equipment are even greater.

One of the myriad phases of the problem of developing a modern air armada is the necessity of drawing a fine line of demarcation between purely experimental, or research engineering, and production engineering. In the realm of strictly research engineering, we are indebted to the stellar role played by the National Advisory Committee for Aeronautics in the supervision of the very essential scientific laboratory research activities and in the coordination of such research activities to prevent unnecessary overlapping and duplication. This committee also serves a useful function in the field of military experimental engineering, which embraces the practical application of established scientific facts to the development of military aircraft. In this phase of development, the National Advisory Committee for Aeronautics cooperates with our own research laboratory at Wright Field, and also with the Naval Aircraft Branch. The benefits that accrue to the aeronautical branch of our armed forces as a result of this collaboration in research activities cannot be overemphasized.

Our experience since the World War has indicated that a period of almost five years invariably has elapsed between the drawing-board stage and quantity production, between the time when the new model first springs from the brain of the designer until quantities of the aircraft are in the

MAJOR GENERAL HENRY H. ARNOLD

THE ROLE OF THE

hands of our tactical units. One of our principal concerns at the present time is to shorten that period in so far as it is humanly possible. To the end that this may be accomplished, expenditures totalling approximately $12,000,000 during the next fiscal year in experimental development and research have been authorized. It has become clear that we must devote more time and attention to research and experimentation in the United States if we are to excel in the field of aeronautical development.

The matter of experimental development alone has assumed many forms. The development of sub-stratosphere flying by the innovation of "pressure cabin" airplanes, or superchargers, to mention only one outstanding achievement, has greatly increased the effectiveness of our bombers, since they can now operate efficiently at an altitude of more than 20,000 feet. Experimentation in other fields of aviation recently conducted by the Air Corps has led to the perfection of automatic landing devices to the point where "blind flights," and the landing of an airplane simply by attention to the instrument board, are no longer extra-hazardous undertakings. The development of the 2000-horsepower airplane engine, retractable landing gear, high octane fuels, self-sealing gas tanks, armor protection for pilots and crews, not to mention scores of other innovations, have all received their due share of attention.

A revolutionary type of aircraft engine, flat and of smaller size, but with increased horsepower, to fit into the wing of a plane and so reduce "lag," thereby adding 10 per cent to speed and 15 per cent to cruising range, is now under construction. It is also contemplated establishing soon an aircraft engine research laboratory to assure higher speeds for the war planes of tomorrow.

Improved materials, as well as new and improved methods of construction, must constantly be found in order to reduce the time required for the original construction and for daily maintenance and periodic overhaul. Stainless steel is finding greatly increased use in the construction of our new military aircraft, since it is well adapted to resistance welding, while the use of plastics, by which large sections of airplanes can be molded in one piece, is being more and more applied. It is gratifying to note that under the impetus of a greatly increased foreign demand for military airplanes of American manufacture, added to the extraordinary domestic demand created by the present world-wide military exigencies, improvements in airplane design that would ordinarily have required years of experimentation have been accomplished almost over night. The improvements so obtained will logically accrue, per se, to the benefit of the United States Air Corps.

The procurement of aircraft necessarily involves a careful consideration of the military characteristics of our own, as compared with foreign, planes, and their suitability for quantity production. Based upon these considerations, the military characteristics of the airplane are decided upon, and the aircraft industry is then asked to produce an airplane having such characteristics. When the first finished article is delivered, it is treated as a purely experimental product and is subjected to a series of exhaustive tests, including a flight test, an engineering test, a power plant test, and many others. These tests, although time-consuming, are essential before a decision can be reached as to whether or not the plane is suitable for quantity production. After a decision has been reached as to quantity production of a specified standard design, that design must be "frozen," in order to obviate the delays in production necessarily attendant upon constant changes.

ARMY AIR CORPS IN NATIONAL DEFENSE

With the industrial mobilization of our aeronautical industry already well under way, it is hoped that a monthly production capacity of 1200 airplanes and approximately 2300 engines will be attained during the current calendar year. Allied purchases to date well in excess of $350,000,000 in airplanes, engines, and accessories have produced a decided speed-up in production. The completion of an anticipated $500,000,000 additional purchase of military planes of American manufacture by foreign powers, exclusive of ordnance equipment, will further promote the acceleration of production in this country and make available to our Armed Services the increased production capacities of American manufacturers, as a result of their expansion to fill foreign orders. Recent conferences with more than one hundred of our leading aircraft manufacturers confirm the belief that a 50,000-plane annual capacity for the United States in the not too distant future is entirely within the realm of possibility.

In order to secure the trained pilots required to operate the additional planes, plans have been made for the establishment of two new basic and advanced training centers. The capacity of the nine civilian flying schools now operating will be doubled. This will enable the Army Air Corps to train at least 7000 flyers annually. To obtain these men, it will be necessary to examine physically between 60,000 and 75,000 applicants having the necessary educational requirements.

The equipment required to carry out the enlarged training program will necessitate the procurement of approximately 800 additional primary training airplanes; 800 basic training airplanes with engines and spare parts; and 600 advanced training planes with engines and spare parts; 200 B-17 Flying Fortresses are also to be purchased. Provision is being made for additional flying school equipment, flying field equipment, and flying equipment, including clothing and parachutes.

The present war in Europe may be looked upon as a full-scale laboratory in which fighting planes are being service-tested under actual war conditions. Out of the fog of claims and counterclaims by the opposing forces are gradually emerging the distinct outlines of certain military and aeronautical lessons for the United States. From these lessons, a number of tentative conclusions have already been drawn, among which are the following: (1) There is a definite need for leak-proof fuel tanks in modern aircraft. (2) Military aircraft require some armor for vital parts. (3) Present armament of war planes must be increased; the 0.30-caliber machine gun is inadequate for general use and must be superseded by larger caliber guns in order to be effective. (4) Bombers are easy prey to fighting aircraft unless equipped for rear hemisphere firing. (5) More range must be built into bombers. It is self-evident that airplanes can exert no influence in a theater of operations which they cannot reach. That principle was recognized some time ago, as a result of which our four-engine Flying Fortresses were originally developed. The modern prototype of this formidable instrument of warfare still remains as a challenge to the world.

More and more is being learned about the comparatively new and terrible weapon of air power as a result of careful study of its use on the battle fronts of Europe. The air force, like all other weapons, has its own capabilities and its own limitations. It will be more formidable when it is used by those who understand both and employ it in close coordination with other fighting forces. A stronger air force will go a long way toward keeping America out of the war. It has been clearly demonstrated that a strong, well trained, modern air force is absolutely vital in keeping war out of the Americas.

All illustrations official photos U. S. Army Air Corps

"Wright Aero" Plans for

By P. W. BROWN, General Superintendent, Wright Aeronautical Corporation

THE tremendous impetus given to the American aircraft industry by the unprecedented demand for military planes by foreign powers, as well as by the greatly increased domestic demand for fighting and commercial planes, has presented a magnitudinous job to many production men in the aircraft industry. In the building of airplane engines especially, parts that were being produced in fairly limited quantities to meet normal requirements are now being demanded in much greater quantities. Upon the shoulders of production men, naturally, falls the burden of revising many manufacturing methods to meet the suddenly expanded requirements.

The solution of this problem necessitates the purchase of many machine tools and the provision of special tooling, as well as the expansion of heat-treating, inspecting, and other departments. Representative production operations on some of the new machines that have been installed within the last few months to meet the changed production requirements of the Wright Aeronautical Corporation, Paterson, N. J., are described in this article. Many of these machines are in operation in a new shop building, 960 feet long by 480 feet wide, which constitutes one of the most modern shops in the aircraft industry.

Four operations are performed on each of the twenty-eight valve guide holes in steel crankcases by the Ex-Cell-O indexing type of machine shown in Fig. 1. Indexing of this machine to carry each hole successively to the four stations is accomplished hydraulically, and the tool-heads are also operated back and forth by hydraulic power. The valve guide holes are arranged in groups of seven in two rows at both ends of the crankcase. Before this operation, three small holes are drilled for development into each finished valve guide hole.

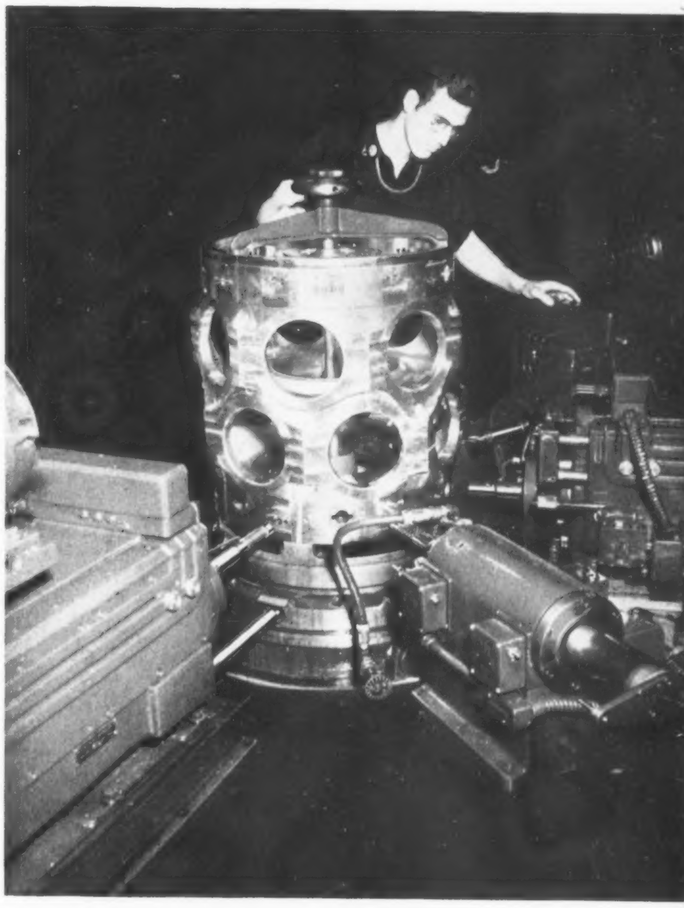
When an operation is started on any group of the valve guide holes, the first head at the right, as seen in Fig. 1, advances for a redrilling operation on one of the holes, the other three heads remaining stationary. Then, after the work has been automatically indexed one station, the first head

advances to repeat the operation on the next hole, and the second head advances for boring the hole previously redrilled, the third and fourth heads remaining idle. After a second indexing, the first two heads again perform their operations on holes that have been brought into line with them, and the third head advances for push-broaching the first hole, the fourth head alone remaining stationary. When the crankcase has again been indexed, the fourth head reams the first hole while the other tool-heads repeat their performance on the valve guide holes that have been indexed to their stations.

This cycle of operations is then continued until the seventh hole is indexed away from the first tool-head, at which time this head becomes idle while the other three heads continue operating. The second and third heads become idle with two more indexings, respectively, and, finally, the fourth head, at which time the machine stops automatically. The work-fixture is then raised to bring the second line of valve guide holes at the same end of the crankcase into the horizontal plane of the tool-spindles, after which the complete cycle of the machine is repeated. The crankcase is then turned end for end on the table for machining the two rows of valve guide holes at the opposite end of the crankcase in similar fashion.

The broach employed in the third station of this machine merely cuts away the sharp corners where the large central portion of each guide hole joins the smaller adjacent holes that form slots. Each tool is provided with a pilot that enters a bushing in the work-fixture for accurate guidance.

Several Natco multiple-spindle drilling machines equipped with a work-table that is moved pneumatically into the working and loading positions, have been installed. One of these machines, which



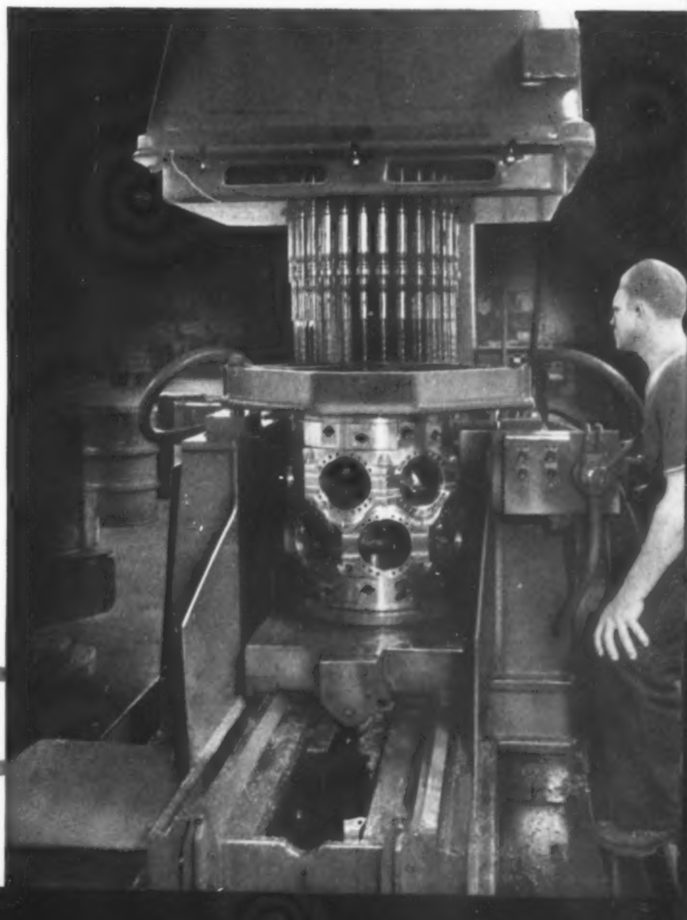


Fig. 1. (Top) Machine Equipped with Four Hydraulically Actuated Heads that Perform Four Operations in Succession on Twenty-eight Valve Guide Holes in Steel Crankcases

Fig. 2. (Bottom) Drilling Twenty-eight Holes Simultaneously in a Steel Crankcase on a Machine Having a Table that is Automatically Moved Forward for Reloading

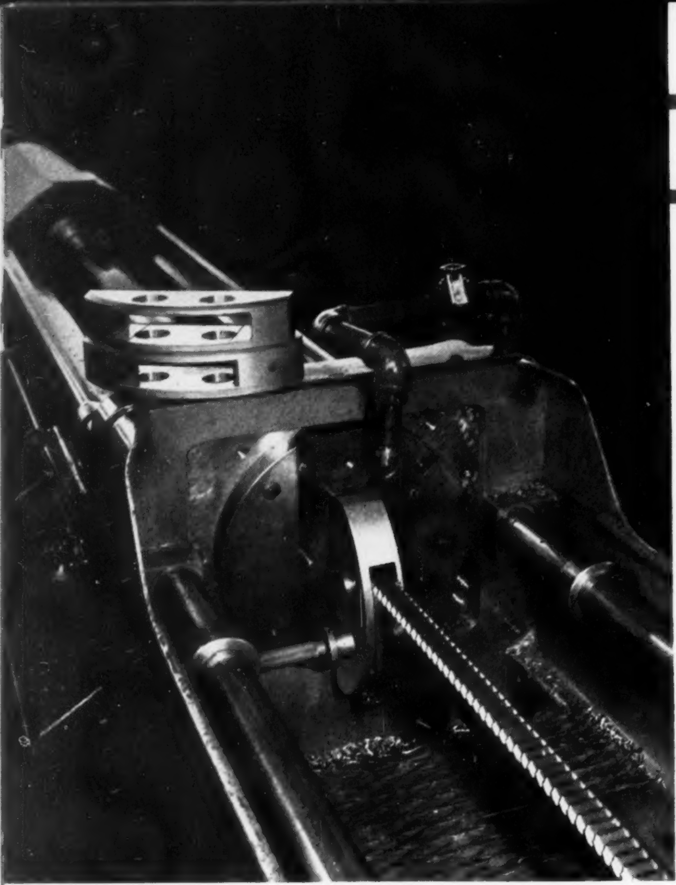
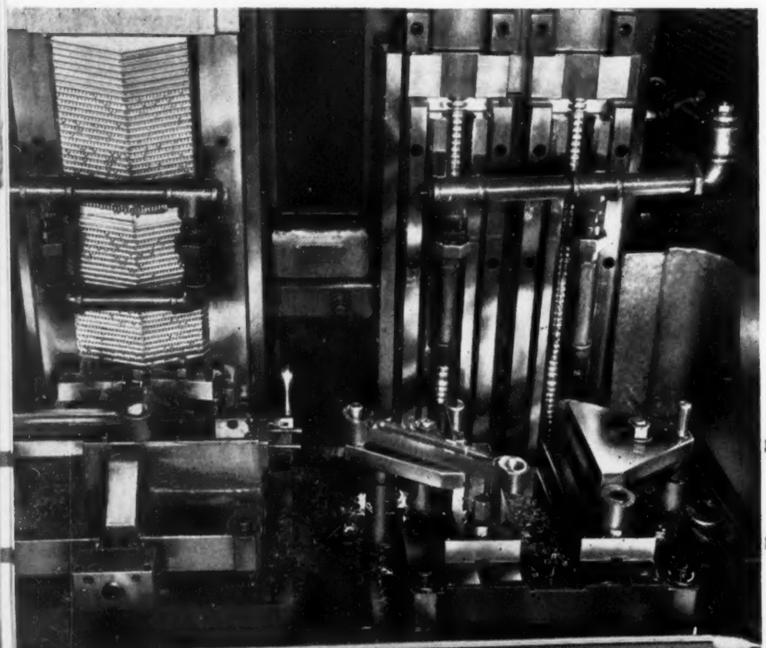


Fig. 3. One of a Series of Five Broaching Operations Performed by a Horizontal Machine on the Rectangular Slots of Counterweights

Fig. 4. Broaching Machine Used for the First Machining Operations on Outside Surfaces of Articulated Connecting-rods



is employed for drilling twenty-eight holes, 5/16 inch in diameter, simultaneously in the end of the steel crankcases, is shown in Fig. 2. These holes are later tapped. The sliding table facilitates the loading of the heavy crankcases.

The same machine, equipped with two different work-fixtures, is used for drilling and reaming mating holes in the nose and supercharger sections for attachment to the ends of the crankcase. In these drilling operations, lubricant flooded on the top of the jig bushing plate flows down the drill flutes to the work. The jig bushing plate is lowered on the work by turning a crank-handle.

Articulated connecting-rods are broached completely over all outside surfaces, with the exception of the channels, by the Colonial dual-ram upright broaching machine illustrated in Fig. 4. The channel sides and the boss faces are first broached in this machine with different tooling from that shown. Then, after a lot of rods has gone through these operations, the broaches and fixtures shown are substituted on the machine.

The tooling on the left-hand side of the machine is employed for broaching one flat arm surface on one rod at a time, the rods being reversed in the fixture for broaching the opposite flat sides. The connecting-rods are then placed endwise in the two stations of the right-hand fixture for broaching the round boss ends, the rods being also reversed in this fixture for broaching both ends. Only enough stock is left on the connecting-rods for grinding purposes.

The fixtures are loaded at the front of the table, and are automatically moved into the broaching positions while the broaches are at the top end of their strokes. At the end of the working strokes, the fixtures are again moved into the reloading positions before the broaches come up. When one of the broach slides is going down the other is rising, thus enabling the fixture at the left to be loaded while work in the right-hand fixture is being broached, and vice versa. The back and forth movements of the fixtures on the table are effected by hydraulic means, and the broach rams are also actuated hydraulically. An overhead hoist and track enable the broaches and fixtures to be changed easily.

Broaching operations of considerable interest are also performed by the Colonial horizontal type of machine shown in Fig. 3, which machines the rectangular slots that extend through dynamic counterweights. Lying on top of the machine are

two of these counterweights, the bottom one showing the appearance of the slot before any broaching is performed, and the top counterweight the appearance of the slot at the end of the broaching.

The particular operation illustrated consists of rough-broaching the rectangular slot at the top and bottom in two steps, the counterweight being located on the fixture by a cylindrical plug that passes through one of the reamed pin-holes in the counterweight and through a bushing in an arm of the fixture.

All together, five broaching cuts are taken on the counterweights by this machine. After the excess stock at the top and bottom of the slot has been broached out with the equipment shown on a lot of parts, the broach is changed for another, which machines the two ends and both sides of the slot in one pass. Then a third broach is substituted, which cuts a relief simultaneously on both sides of the slot for a length of approximately 6 inches. Finally, this broach is again changed for one that finishes both ends of the slot in one pass. The slot in the particular counterweight handled by the equipment illustrated must have an over-all length between 8.362 and 8.366 inches, similar tolerances being specified for the slot widths.

Drilling and reaming of the two pin-holes through these counterweights are performed by the Foote-Burt machine shown in Fig. 5, which is equipped with a three-station indexing fixture and a multiple-spindle head provided with three sets of tools. In the first working station, at the front of the machine, the two holes are drilled in the counterweight to a diameter of 1 inch; in the second station, at the left, they are drilled to a diameter of 2 1/16 inches; and in the third station, at the right, they are reamed.

The counterweights are accurately located in the fixtures by hardened and ground blocks, and are clamped by bars that are pushed down on top of them by the action of hand-operated cams. Bushings are provided for the drills and reamers in the jig plate. The fixture base is hand-indexed, and the multiple-spindle head is operated hydraulically.

Three Conomatics have been installed for the rapid production of parts from bar and tubular stock. The 4 3/8-inch four-spindle machine illustrated in Fig. 6 is tooled up for producing intake pipe nuts from seamless alloy steel tubing. In this operation, the tubular piece is completely machined both inside and outside before being cut off.

The tubular stock is fed forward to a swinging

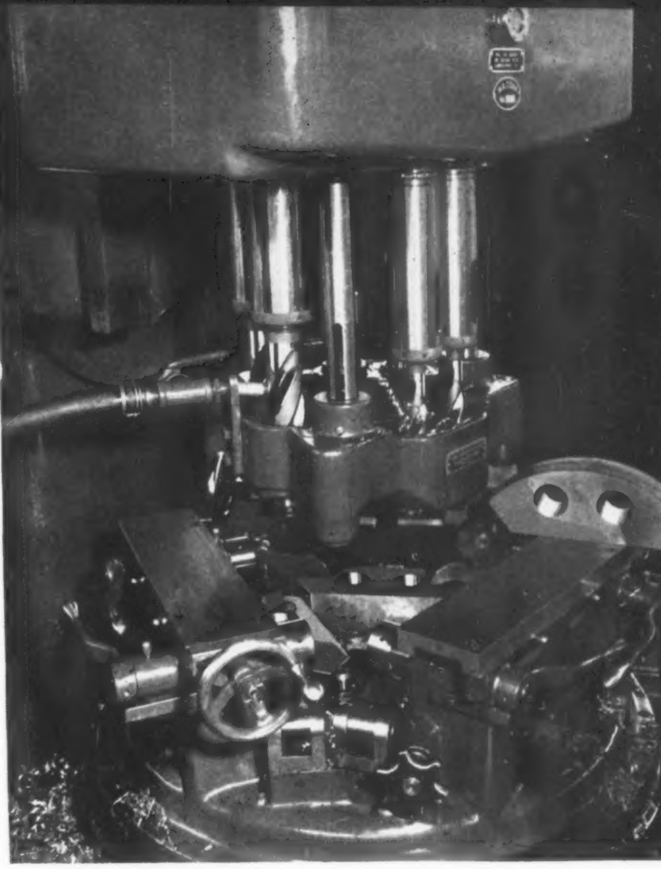
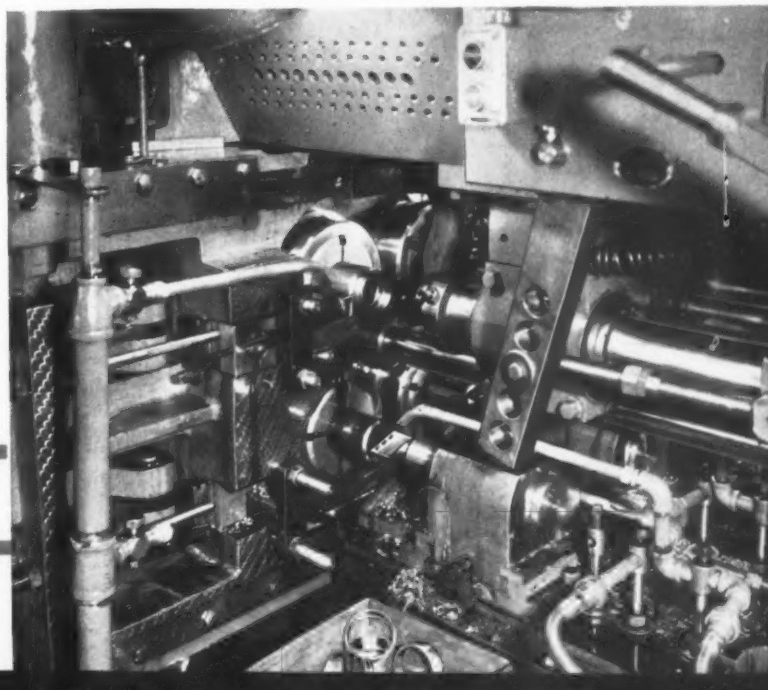


Fig. 5. Machine that Performs Two Drilling Operations and a Reaming Operation on the Two Pin-holes in the Counterweights

Fig. 6. Large Conomatic Tooled up for the Production of Special Nuts from Tubular Alloy Steel Stock



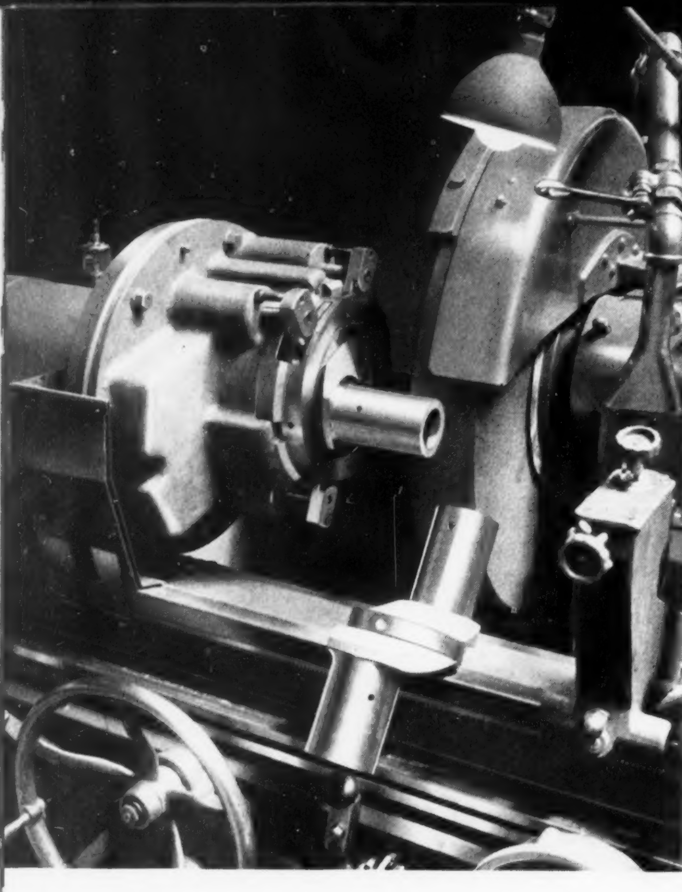


Fig. 7. (Left) Plunge-cut Grinding is Employed in Finishing the Crankpins of Crankshaft Center Sections to the Required Limits of Accuracy

stop in the upper front station. Then, after being indexed to the lower front station, a tool on the main tool-slide bores the inside of the tube. In the second station at the lower rear, counterboring and chamfering cuts are taken by tools on the main slide, a tool on the rear cross-slide at the same time turning the outside of the tube the required length for one piece of work. In the top rear position, a form cutter on the rear cross-slide finishes the outside of the tube to the required contour, while a tool on the main slide chamfers the inside edge of the stock. Finally, in the top front position, the piece is cut off by a tool on the front cross-slide before the stop swings into its operative position. Normally, a sheet-metal chute extends from below the top front position to the receptacle at the front of the machine.

After the center section of crankshafts has been machined all over, the crankpins are ground in the Norton cylindrical grinding machine shown in Fig. 7, which is equipped with a wheel 36 inches in diameter by 5 inches face width. This machine operates on the plunge-cut principle, being fed straight in toward the work for grinding approximately one-half the length of the crankpin, after which the table of the machine is adjusted longitudinally for finishing the remainder, which is also done by feeding the wheel straight into the work. When one crankpin has been finished, the work is reversed in the eccentric fixture for grinding the opposite crankpin, the crankshaft in each case being located from the rough-ground center bearing. Limits of plus or minus 0.001 inch are held on the crankpin diameters in this operation, final grinding to size being done at assembly.

Both sets of lobes on cams are milled simultaneously on the duplex Van Norman milling machine

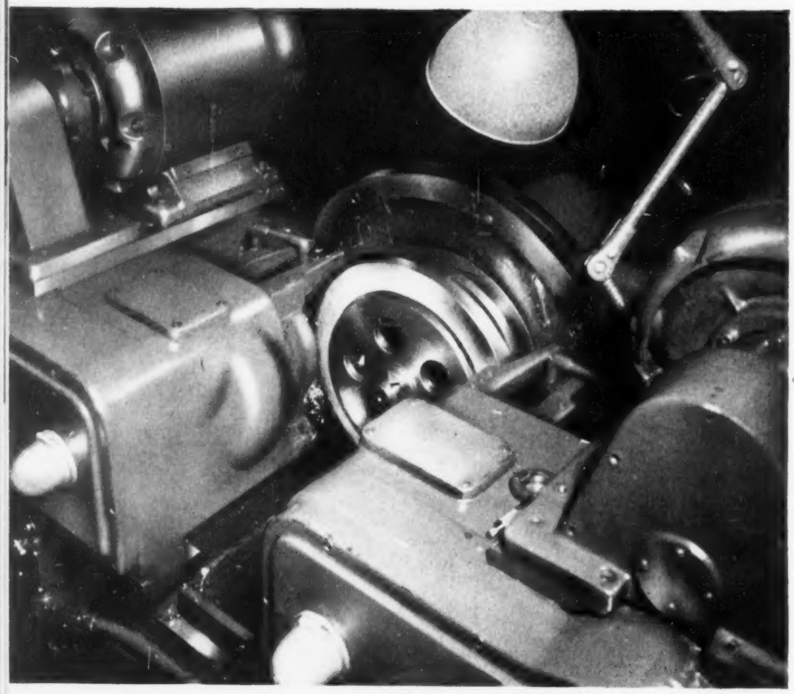


Fig. 8. (Center) Lobes of Engine Cams are Milled in a Machine with Two Cutter-heads that are Moved Sidewise by Master Cams

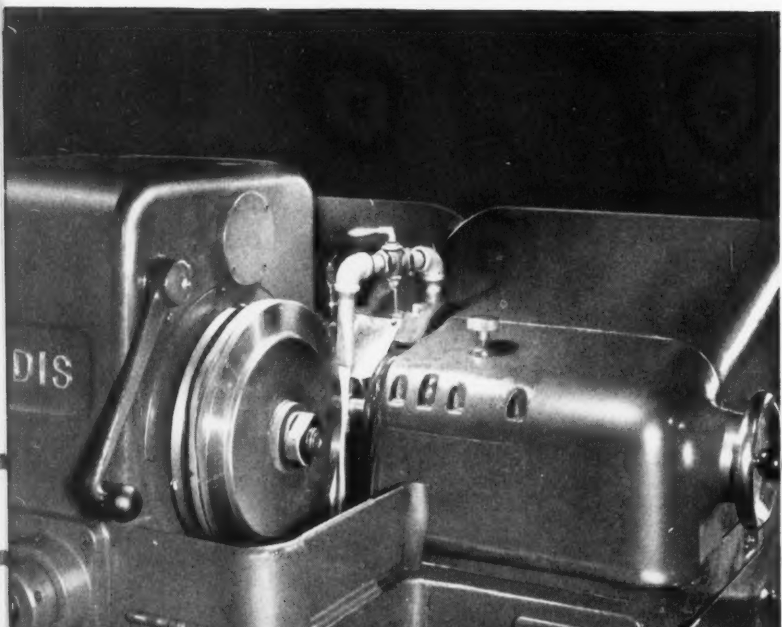


Fig. 9. (Left) Grinding the Groove between Engine Cam Lobes on a Machine of the Type that is Also Employed for Grinding the Lobes

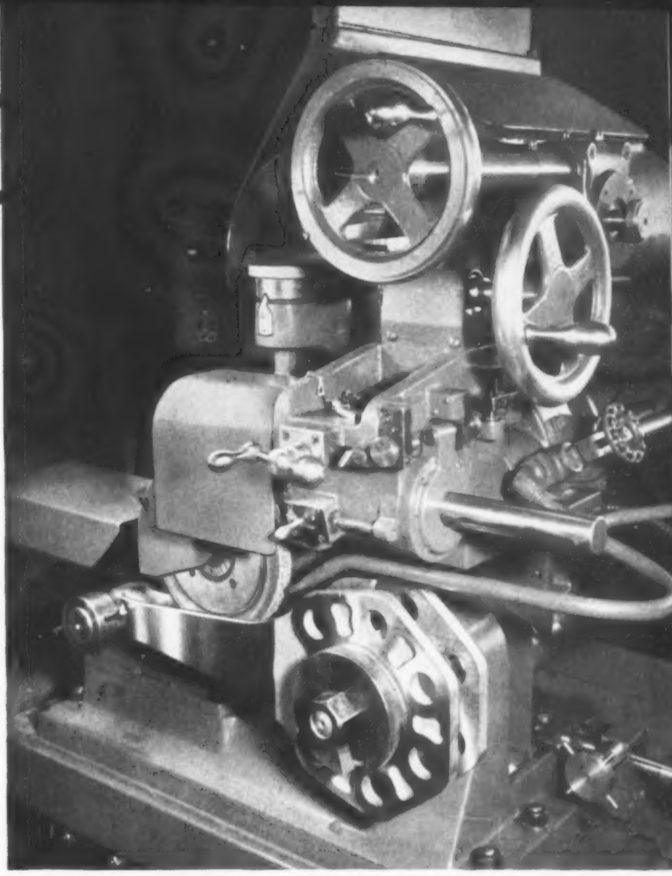


Fig. 10. (Right) Grinding the Channel of a Master Connecting-rod on a Machine Having a Grinding Head that is Raised and Lowered by a Master Cam

illustrated in Fig. 8. Rollers attached to the two cutter-heads of this machine ride on master cams mounted on the work-arbor directly in back of the work, the rollers being held in contact with the cams by hydraulic pressure. With this arrangement, the heads are moved sidewise in accordance with the contour of the master cams as the work-arbor revolves, and the required accuracy of the work is insured.

Eleven Landis cam grinders are used for rough- and finish-grinding the cam lobes and the groove between the lobes in separate operations. The grinding of the groove between the lobes is being performed in the operation illustrated in Fig. 9. In grinding the lobes, unusually close accuracy is insured by the use of a cam on the work-spindle, which imparts in and out movements of the work-head with respect to the grinding wheel.

The method of grinding the channel section of master connecting-rods is shown in Fig. 10. This operation is performed on a Thompson grinding machine so arranged that as the work is fed past the grinding wheel, the desired profile is obtained through the action of a cam which raises and lowers the grinding wheel. The inside of the cheeks on master connecting-rods is ground by another Thompson machine illustrated in Fig. 11, which is equipped with a rotary fixture on the table that swings the connecting-rod about the center of the crankpin bearing for grinding to the proper radius. This fixture is power-operated.

Quantity production is featured in the operation illustrated in Fig. 12, which consists of grinding the sides of a quantity of articulated rods on a Pratt & Whitney surface grinder.

The second installment of this article will be published in a forthcoming number of MACHINERY.

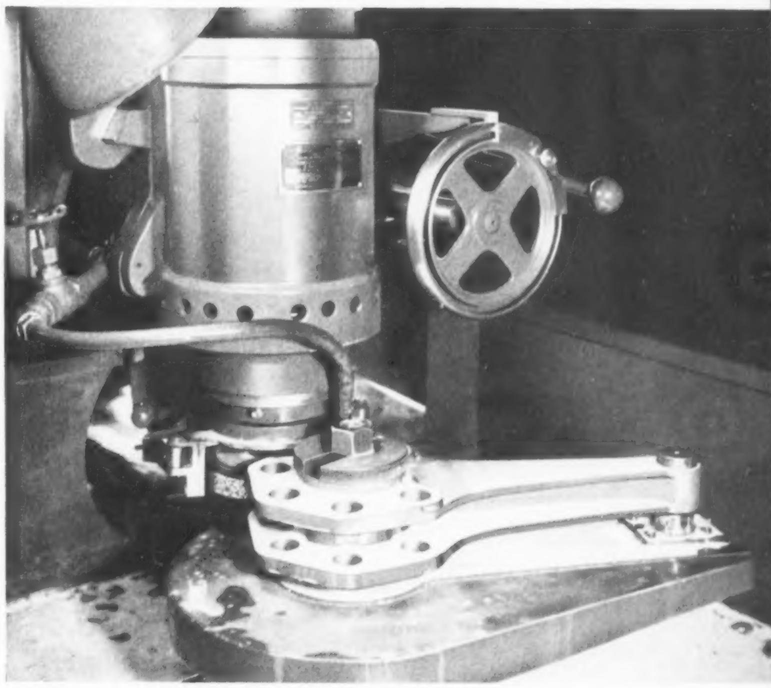


Fig. 11. (Center) The Crankpin End of Master Connecting-rods is Ground on the Inside of the Cheeks, Using a Rotary Fixture

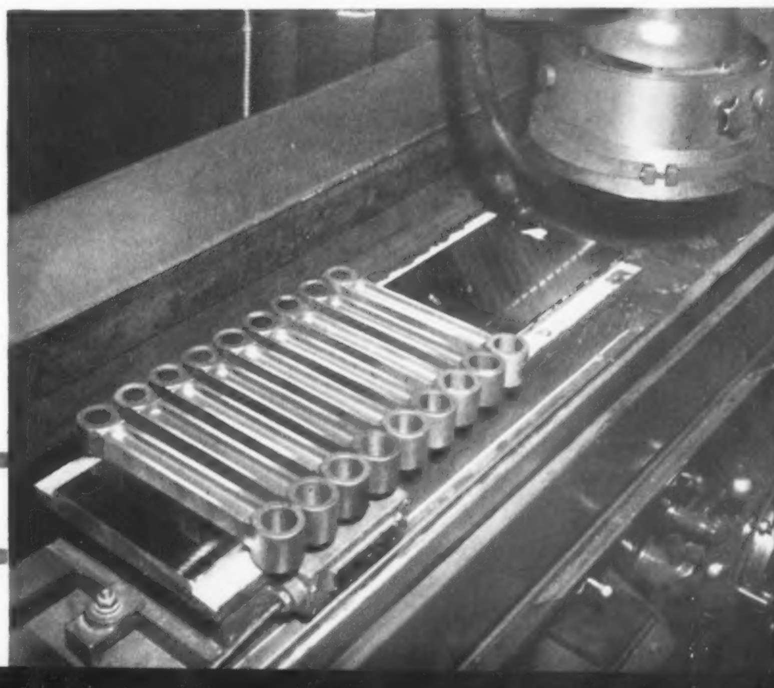


Fig. 12. (Right) Bosses of Articulated Connecting-rods are Ground on a Surface Grinding Machine on a Quantity Production Basis

Lockheed Builds Planes for

By J. H. SREENAN

Factory Manager, Lockheed Aircraft Corporation
Burbank, Calif.

LIKE all other important concerns in the airplane-building industry, the Lockheed Aircraft Corporation, Burbank, Calif., is literally swamped with orders for military planes required by the armies of the United States and foreign powers. However, even with a huge backlog of orders for bombers and pursuit planes, most of the engineering thought of this company is being directed toward the development of commercial transports. This is attested by the fact that of the 138,000 working hours in June, which was a typical month, 95,000 hours, or almost 70 per cent, of the engineering effort was spent in the drafting of commercial planes.

The Lockheed Aircraft Corporation specializes in the building of bombers, pursuit planes, and commercial transports. Heretofore, the commercial ships have been of medium size, with capacity for carrying up to fourteen passengers and a crew of three; but there is a new model in the course of production known as the Excalibur, which will carry thirty passengers and operate at speeds up to 300 miles an hour. Together with its subsidiary, the Vega Airplane Co., this concern had a payroll on July 1 of approximately 10,000 persons.

Whether building airplanes for commercial or military purposes, the methods of manufacture are substantially the same. At the Lockheed factory, there are many operations that indicate the progressiveness of the aircraft industry's production men in devising methods to meet the manufacturing needs of that industry. Some of them will be described in this article.

One of the most striking machines in the factory is the huge Watson-Stillman hydraulic press shown in Fig. 1, which has a capacity of 4500 tons. Operation of this press in the flanging and forming of sheet-metal parts is greatly expedited by roller

tables that lead to the platen from both sides and extend completely around the front of the machine. Large steel plates are customarily loaded with forms and aluminum-alloy or stainless-steel sheets on these roller tables while work on a similar steel plate is being formed under the press ram. When a plate of finished work is withdrawn from one side of the platen, another is immediately pushed in from the opposite side, thus minimizing idle press time. The steel plates are moved along the roller table for unloading and reloading the work and forms.

The steel plates are automatically fed along the roller tables by dogs on a conveyor chain which engages the back end of the plates. The forms or dies used for shaping the sheet-metal work-pieces are generally made from Super Masonite, and are light enough to be handled easily. Metal strips are fastened to the forms for shaping beads and similar elements on work-pieces. The press ram is fitted with rubber pads, 124 inches long by 48 inches wide by 5 inches thick, having a Shore scleroscope reading of 75 to 80. This rubber forces the metal to be shaped down over the edges of the Masonite forms. In Fig. 4 is shown a somewhat similar installation of a Farrel-Birmingham hydraulic press that develops a pressure of 2500 tons.

One of the most recent installations is the Chambersburg Cecostamp illustrated in Fig. 2, which applies pneumatic pressure for forming sheet-metal pieces between Kirksite and lead dies, as commonly performed on rope drop-hammers. This press has a maximum die area of 60 by 68 inches, and is shown in both Figs. 2 and 3 equipped for the production of a rather difficult part, which has a square depression in the center and a series of corrugations. The piece is 34 inches long by 20 inches

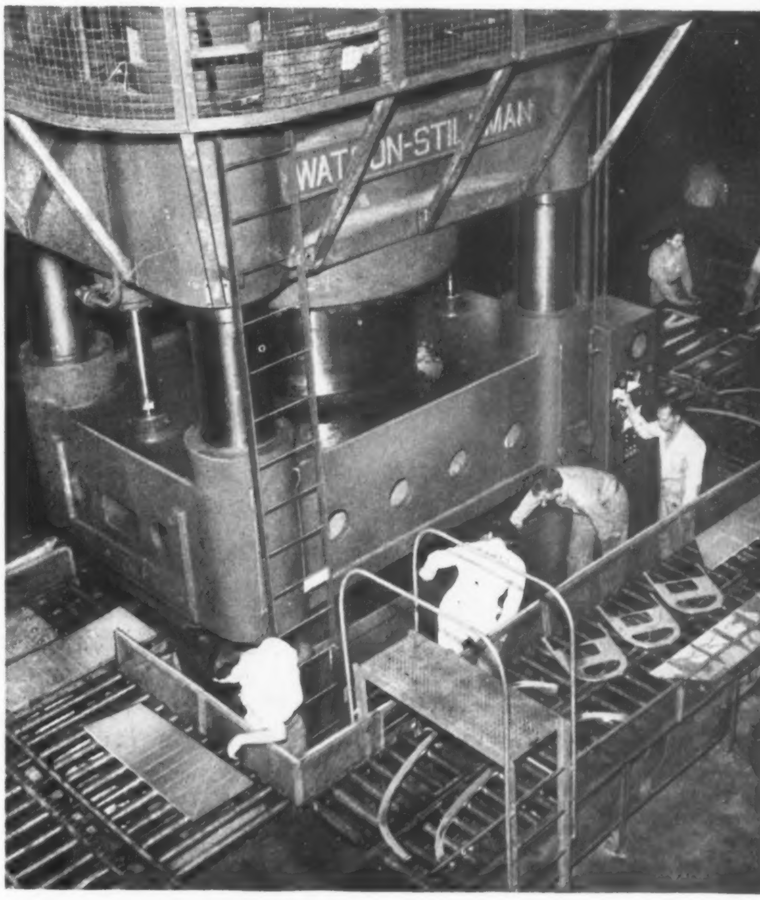


Fig. 1. (Above Right) Huge Hydraulic Press that Develops a Pressure up to 4500 Tons for the Forming of Sheet-metal Pieces over Masonite Forms

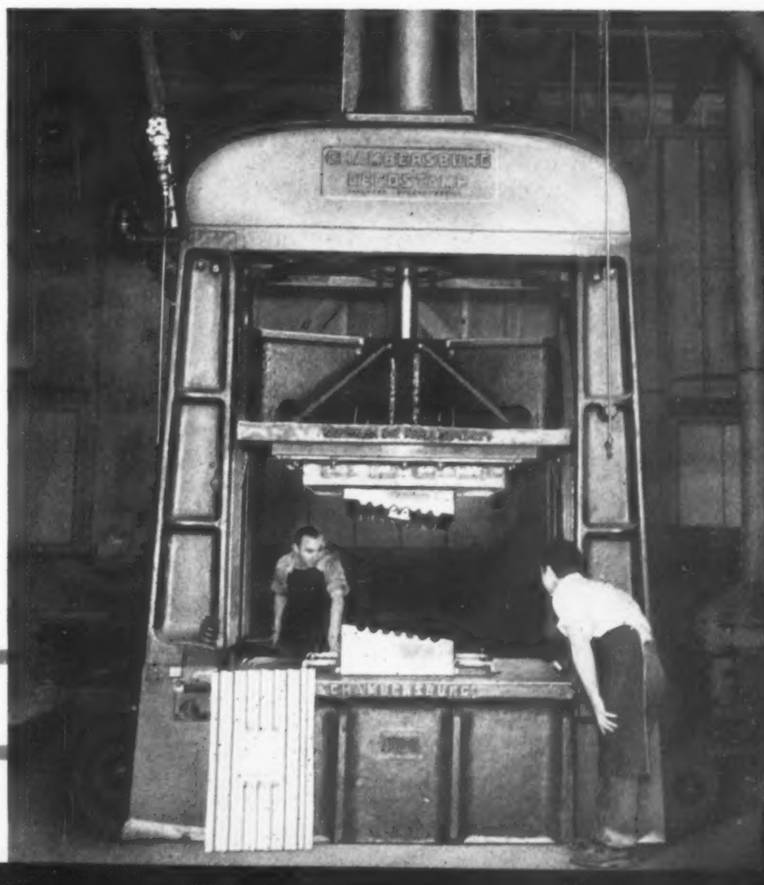


Fig. 2. (Right) Cecostamp Pneumatic Hammer which Forms Pieces from Aluminum-alloy and Stainless-steel Sheets between Kirksite and Lead Dies

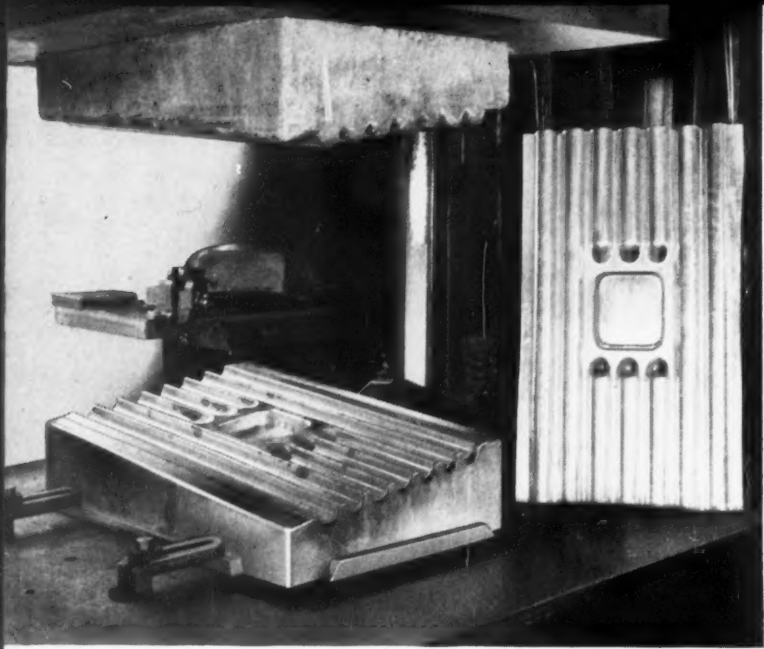


Fig. 3. Close-up View of Cecostamp Hammer, Showing Typical Punch and Die Members and a Sample of the Work Produced

wide when finished, and the corrugations are 1 1/4 inches deep. Both Alclad aluminum-alloy and stainless-steel sheets are formed by this equipment. The press is installed on an I-beam foundation, and is equipped with twelve spring type shock absorbers to take up the heavy blows.

Metal sheets to be formed under the hydraulic presses are first cut to the desired outline by routers of the type illustrated in Fig. 6, which consist of high-speed spindles mounted on the outer ends of swinging hinged arms. The routing spindles are driven by high-cycle electric motors running at 10,800 R.P.M. From six to eight sheets are generally stacked on top of each other on plywood boards laid on the routing table to obtain a total thickness of about 7/16 inch, and templets of Masonite are placed on top of the stacked sheets, as illustrated, and screwed to the plywood board underneath. In this way, a large variety of parts can be routed from the sheets of stock with minimum waste of material.

Above the routing tool is a fixed bushing that is slightly larger in diameter than the tool. This bushing is guided around the templet to cut out the stock to the desired outline, allowance being made on the templet for the fact that the bushing is of greater diameter than the cutter. The routing cutter is 5/16 inch in diameter, and is of the spiral type. The cutters vary in size by increments of 1/64 inch, and guide bushings are provided to suit.

Before these sheets are routed into blanks, however, they are accurately drilled according to steel templets or jigs that are only 0.005 inch in thickness, such an operation being illustrated in Fig. 5. Locating holes in these templets are made 5/16 inch in diameter to receive a "finder" attached to the lower end of the drill spindle. This finder serves both as a means of accurately locating the drill for each drilling step and as a bushing to guide the drill accurately through the stack of sheets. One of these finders is seen lying upside down near the front end of the stack of sheets in the left foreground of the illustration. There is a locating nose on the finders which is of approximately the same length as the thickness of the templet and is of the same diameter as the templet holes. The finder shank is provided with a groove which is engaged by a ball lock for attaching it to the drill spindle.

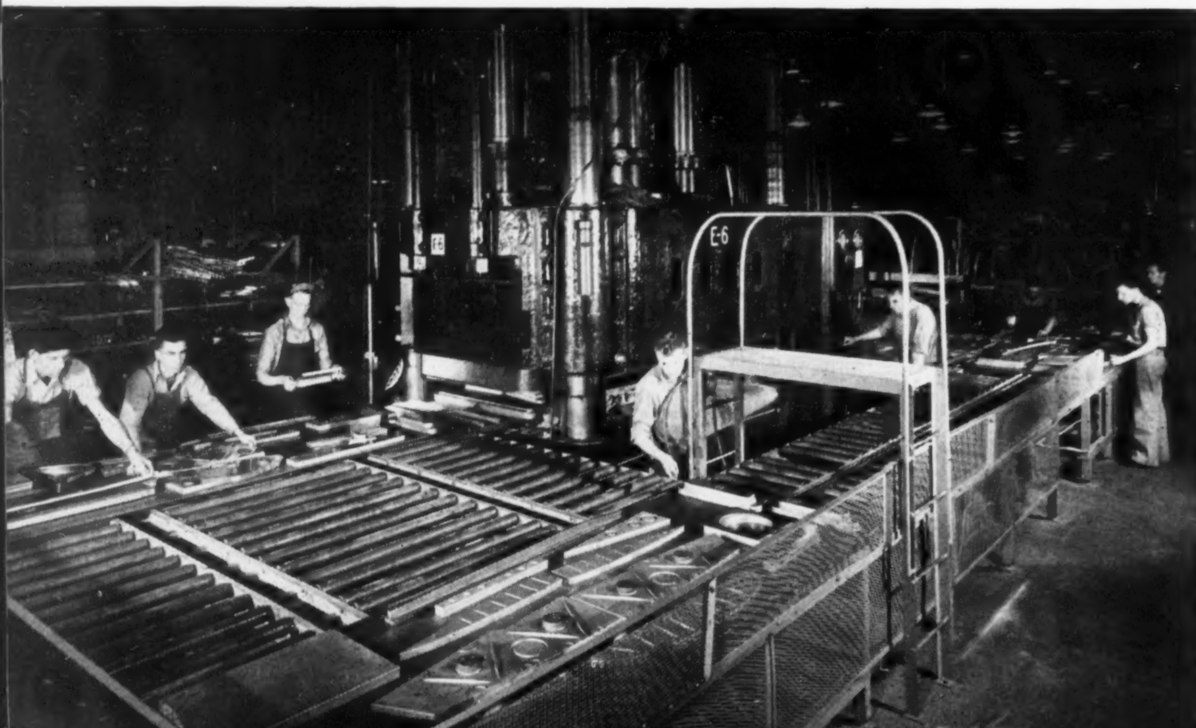


Fig. 4. Hydraulic Press of 2500 Tons Capacity which is Equipped with Roller Work-tables Similar to the Press Shown in Fig. 1

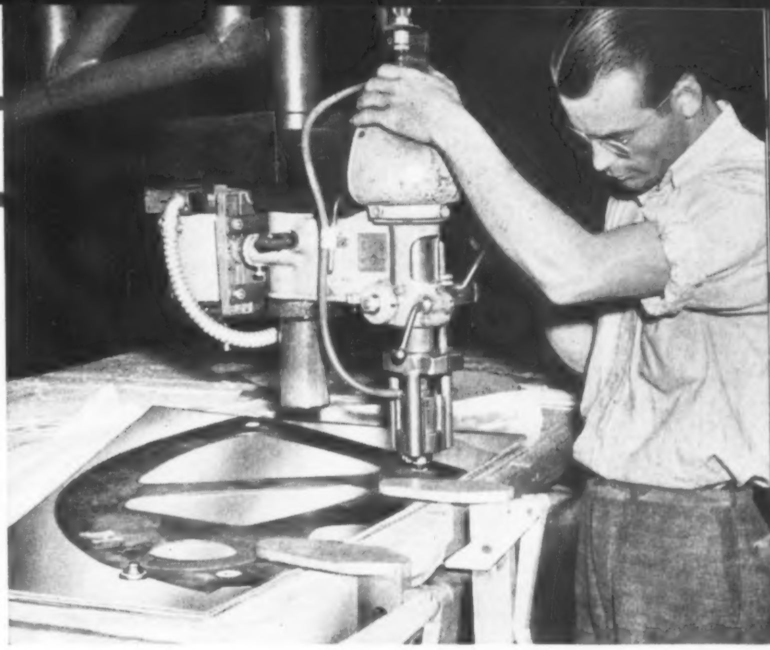


Fig. 5. Locating and Rivet Holes are Accurately Drilled through Stacks of Sheets by Using Templets and a "Finder"

As in the case of the routing operation, a stack of sheets is built up on a plywood board for multiple drilling in the manner just described, and drilling templets are used for all the blanks to be routed from the same sheets. Thus, in the routing operation, the sheets can be accurately located from the drilled holes, the steel templets being removed and the Masonite routing templets substituted, after which the stacks of sheets with the plywood board to which they are attached are passed to the routing machines.

As many as 500 holes are frequently drilled through the stack of sheets in the manner described, some of them for locating purposes in routing and subsequent operations, and others for receiving rivets in assembling operations. The drill heads are also driven by high-cycle electric motors at speeds ranging from 1700 to 5600 R.P.M. Timken tapered roller bearings in the radial arms provide a finger-tip movement of the drill head over the sheets.

Lockheed planes are among the few equipped with completely arc-welded engine mounts. Tubes for the front end of these mounts are rolled to the desired radius by means of the Buffalo machine illustrated in Fig. 7, which is equipped with rolls of the required diameters that are grooved to suit the size of tubing being handled. The illustration shows the machine set up for rolling 1 3/4-inch seamless tubing of S A E steel specification X4132, having a wall thickness of 0.083 inch. The tubes are rolled into circles 30 inches in inside diameter during several passes back and forth through the rolls, between which adjustments are made. Guides on both sides of the rolls help to keep the tube ring flat. This machine is also used for rolling a large variety of other work from angle, channel, and other structural shapes that were previously bent by hand methods.

Approximately 60 feet of arc welding is performed on one engine mount, all of which is done with the various parts that make up the mount held in jigs, so as to insure complete interchangeability. The ends of the rings formed in the Buffalo rolls are welded together, and lugs are welded to the rings before they come to the final welding jig shown in Fig. 8. Likewise, the legs or braces are welded together in a separate jig before they

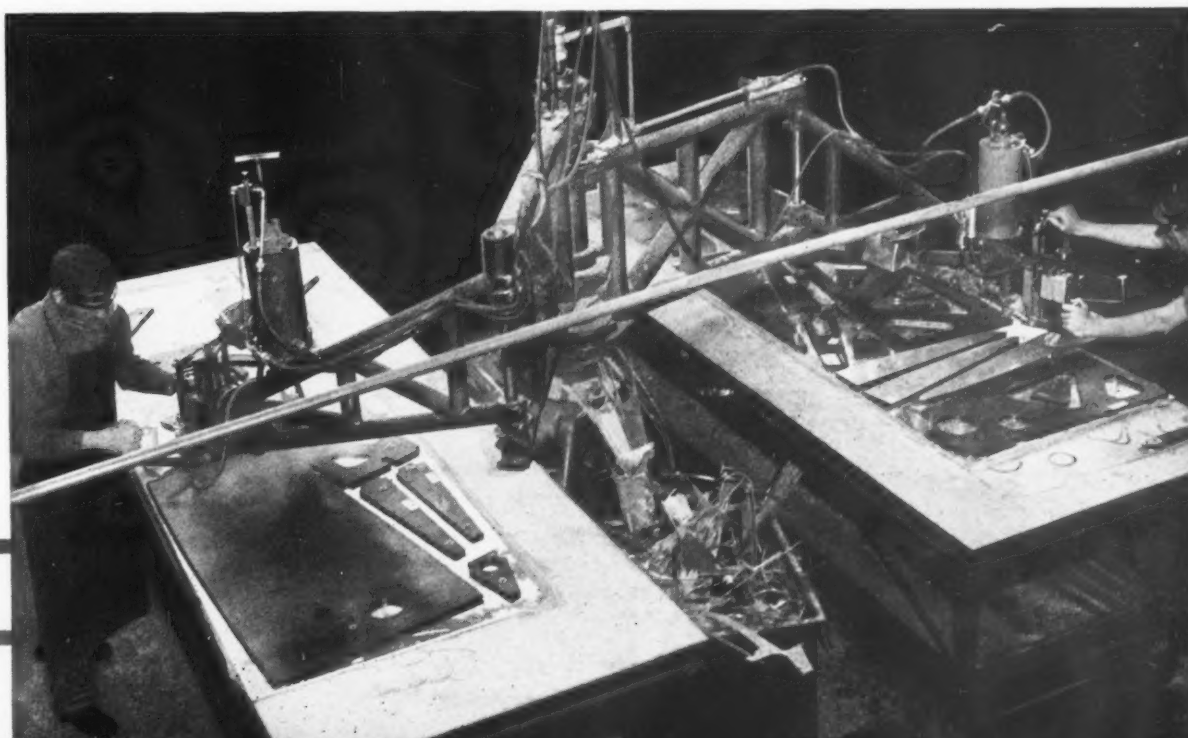


Fig. 6. Routing Machines Used for Cutting Blanks from Stacks of Sheet Metal According to Templets Fastened to the Sheets

Fig. 7. (Left) Rolling a Ring from Seamless-steel Tubing for Use on the Front End of Engine Mounts

reach the assembly welding operation. For the latter operation, the legs are clamped to locating lugs attached to a flat plate at the back of the jig, and the ring is fastened to a circular plate at the front, which is equipped with slides that engage the ring lugs. While the parts are mounted in this manner, the ring is welded to each of the braces. The entire jig swivels through 360 degrees to facilitate the welding.

To prevent warping of the engine mount due to the shrinkage that occurs as the work cools after welding, the bars used to fasten the legs to the jig are backed up by springs on the rear side of the square plate. Thus, the legs are permitted to expand lengthwise and again return to their normal shape without deflection as they cool. Similarly, the slides that attach the ring lugs to the jig are allowed to move in and out radially, so that the desired contour of the ring is maintained. Lincoln and Hobart arc welders are used.

Unusually close limits of accuracy are maintained on the center distances of the holes that are drilled and reamed through the ring lugs and on the distance from the holes in the legs to the faces of the ring lugs. For example, all the lug faces must be in the same plane on this welded structure within plus or minus 0.005 inch, while the holes must be within 0.002 inch of specified center distances. Drilling, reaming, and facing of the ring lugs are, therefore, performed with the engine mount set up in a jig, as shown in Fig. 10, on the base of a Cincinnati-Bickford radial drilling machine. Three drills, one reamer, and a spot-facing tool are applied to each lug hole, the drills ranging from 3/8 to 23/32 inch in diameter. Each hole is completed before the next one is started. There are separate bushings for each tool.

Spot-welders are used for assembling secondary

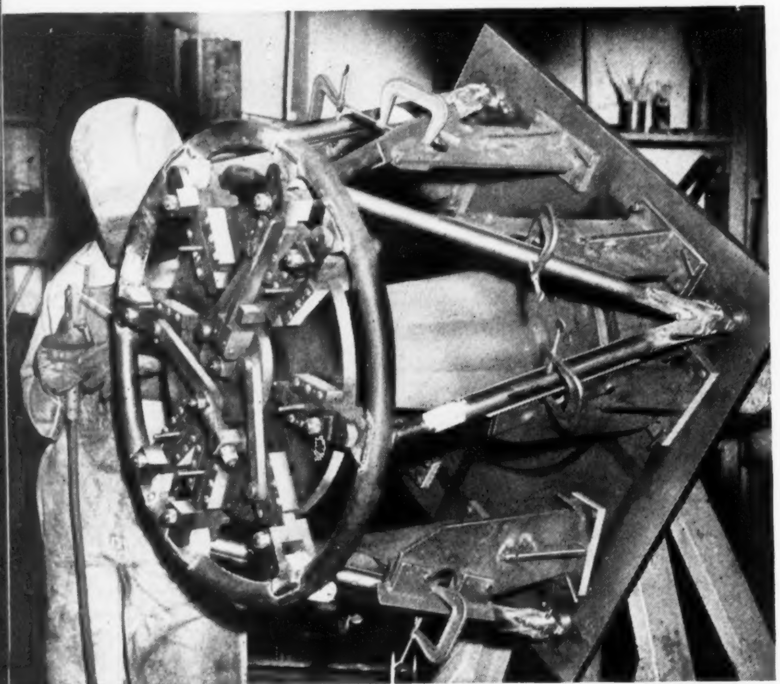


Fig. 8. (Center) Jig Used in Assembling the Ring of Engine Mounts to the Legs without any Distortion Due to Shrinkage

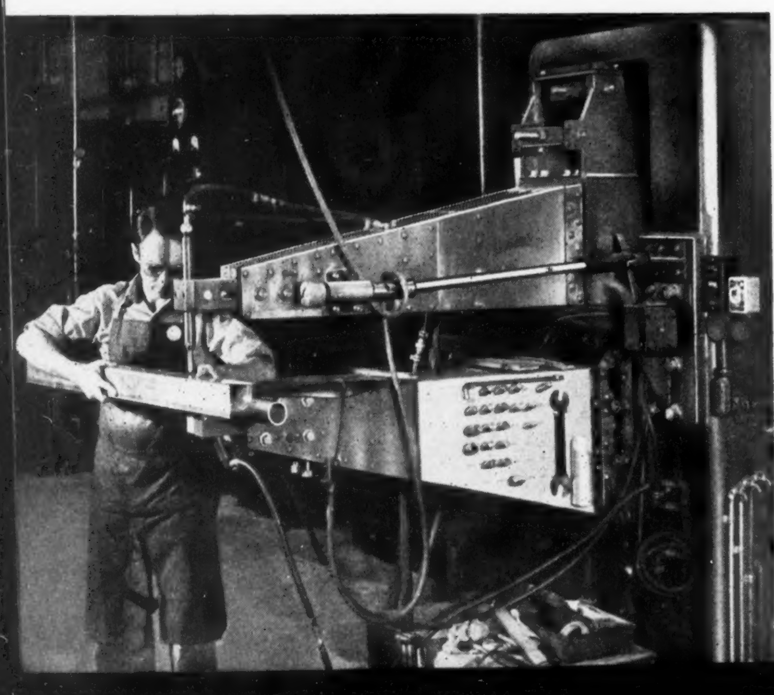


Fig. 9. (Left) One of Two Spot-welders Built with Extra Long Electrode Arms to Accommodate Sheets up to 8 Feet in Length

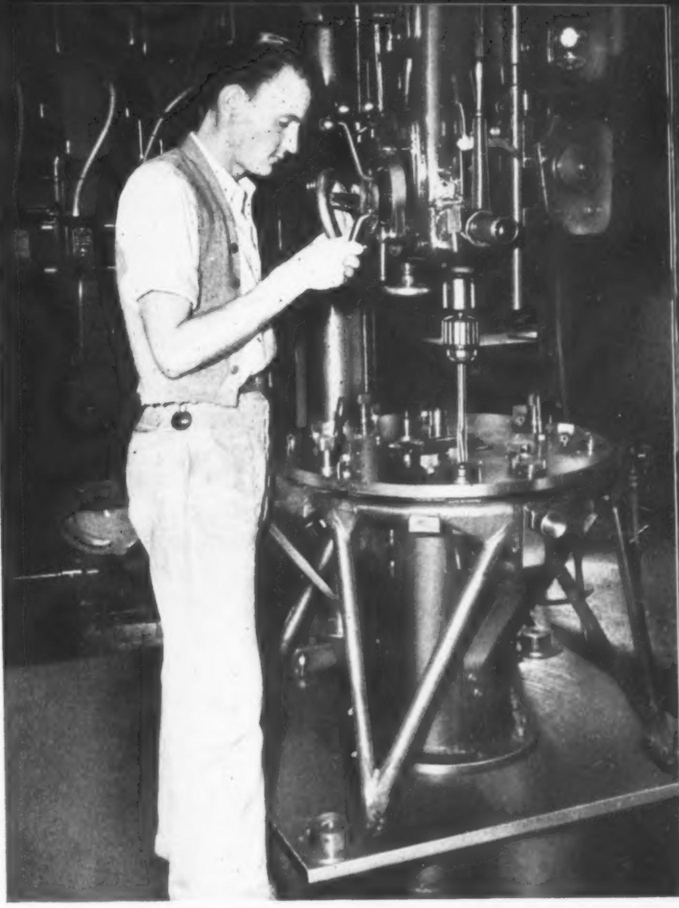


Fig. 10. (Right) Drilling, Reaming, and Spot-facing Lugs of Engine Mounts to Unusually Close Limits

structures as approved by the War Department, such as motor cowling, interior paneling, partitions, doors, storage boxes, and a variety of other parts. Two Federal machines, one of which is shown in Fig. 9, were built with arms 53 inches long to accommodate sheets of aluminum alloy or stainless steel up to 8 feet in length.

A machine that is in constant use in the sheet-metal department is the Niagara shear illustrated in Fig. 11, which can be used for shearing sheets up to 16 feet in length between housings.

All castings and forgings used on Lockheed planes are checked chemically, physically, spectrographically, and by X-rays in a laboratory maintained by the Triplett & Barton Co. at the Lockheed factory. X-rays and physical tests are also conducted on welded structures to determine their ability to perform, without failure, the service for which they are intended.

In Fig. 18 is shown a typical compression test being performed on a piece of corrugated aluminum-alloy sheet by means of a Tate-Emery testing machine built by the Baldwin-Southwark Corporation. This machine can be used for applying loads as great as 300,000 pounds and as little as 1/2 pound, and it registers within an accuracy of one-tenth of one per cent. A stress-strain recorder automatically produces charts for filing and future reference.

There are four X-ray machines in this laboratory, as well as spectrograph apparatus, a high-powered microscope, and complete equipment for making metallurgical analyses of the various materials employed in airplane construction.

Additional operations performed in the fabrication of Lockheed airplanes will be described in a second installment of this article, soon to be published in MACHINERY.

Fig. 11. (Center) Shears Used in the Sheet-metal Shop for Cutting Aluminum-alloy and Stainless-steel Sheets into Working Sizes

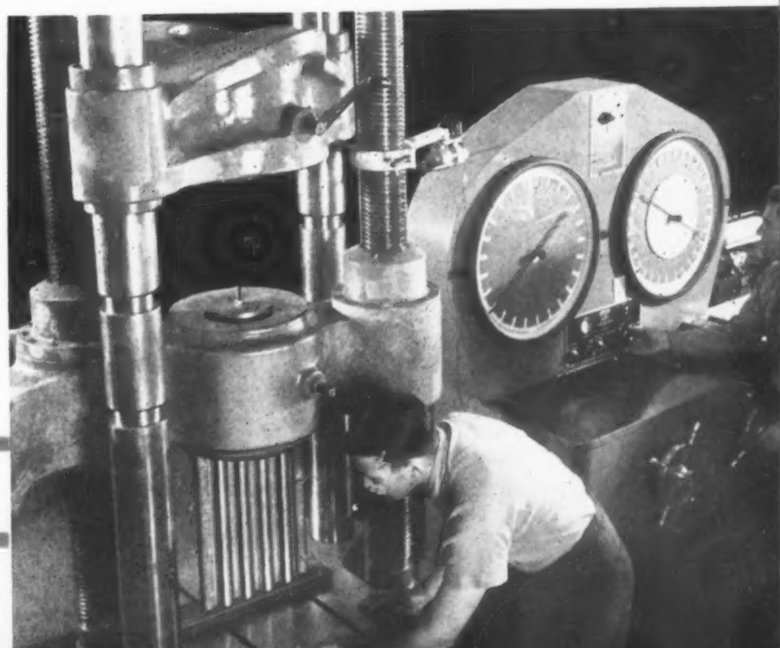


Fig. 12. (Right) Physical Test Being Performed on a Corrugated Sheet of Aluminum Alloy on a Tate-Emery Testing Machine

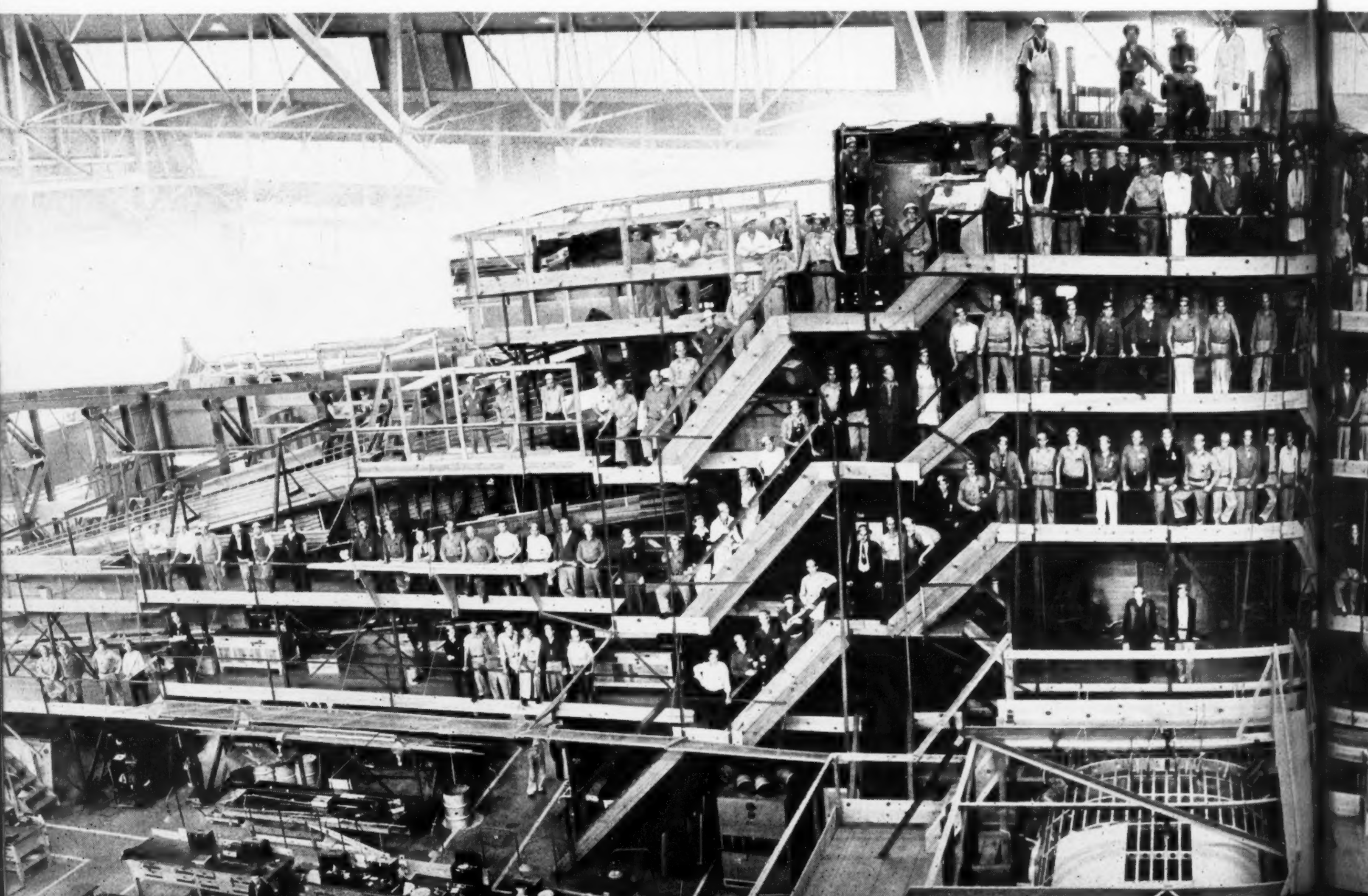
Douglas Builds the World's

AMERICAN aviation will achieve another noteworthy triumph this summer upon the completion by the Douglas Aircraft Co., Inc., Santa Monica, Calif., of the world's largest airplane. The all-metal wings of this plane, a super-bomber for the United States Army Air Corps, will reach more than 210 feet from tip to tip. The cruising range of this "Leviathan of the Skies" will be more than 6000 miles, and it will be able to carry a useful load of 28 tons. The plane will have a gross weight of 70 tons, fully loaded, and will be driven by four radial air-cooled engines having a total rating of 8000 H.P.

The War Department has recently released the photograph reproduced below, which shows a general view of the huge jig in which the wings and fuselage center section of this plane were constructed in a vertical position. The scaffolding, which surrounds the jig, provides seven working levels for the men employed in the assembly operations. The nose section was assembled behind the main jig and the tail section in front.

In common with other aircraft-manufacturing concerns, the Douglas Aircraft Co. is having by far the busiest year in its history, being engaged in building not only a large number of military planes for the British, French, and American air forces, but commercial ships as well for foreign and domestic air lines. The backlog of orders on June 1 amounted to approximately \$140,000,000, and of this backlog, about \$23,000,000 was for commercial planes. The number of employes was over 17,600, whereas in March, 1939, there were only 6225 employes.

Whether parts are being produced for the super-bomber or for the regular military and commercial planes built at the two Douglas plants, the manufacturing operations are substantially the same. One of the outstanding production developments of the aircraft industry has been the Guerin Process of employing rubber in combination with forms of Masonite, steel, zinc, etc., for the blanking, forming, and punching of aluminum-alloy and stainless-steel sheet-metal parts on hydraulic presses. This process enables hydraulic presses to be used for the production of comparatively limited quantities of work from sheet metal without the necessity of providing expensive dies.



Largest Airplane

By GEORGE A. STROMPL
Factory Manager, Douglas Aircraft Co.

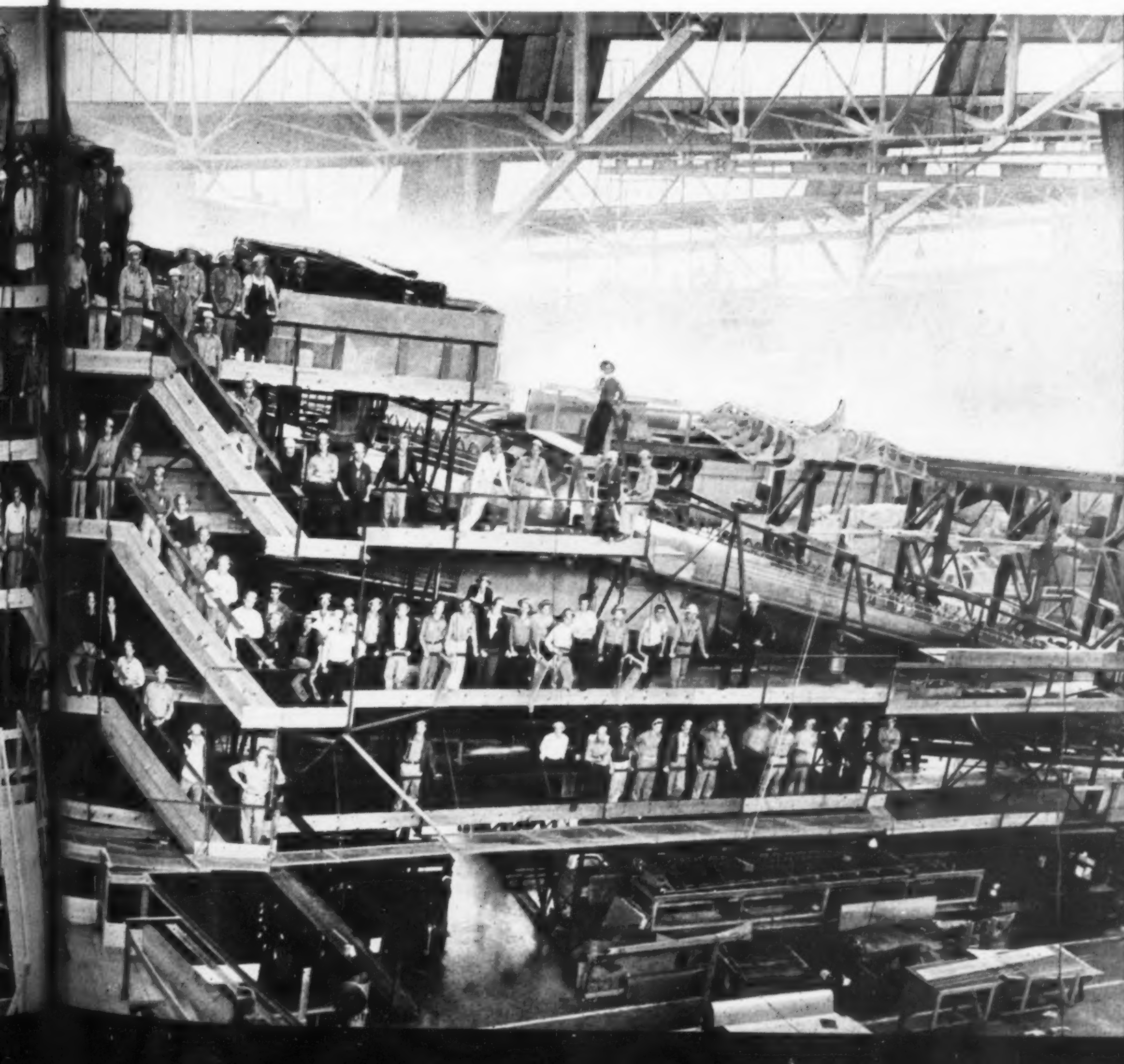
An H-P-M 5000-ton press used for this type of work is illustrated in Fig. 1. There is also a 2000-ton press of the same make employed for similar work. Recently, a 650-ton press of triple-action design, also built by the Hydraulic Press Mfg. Co., was installed for the deep-drawing of sheets from either aluminum alloy or stainless steel. One action of this press operates a blank-holder to grip the stock firmly for the operation; the second action operates an upper or main forming die; and the third action, a bottom die cushion. Zinc and lead dies are used in combination with rubber sheets.

Corrugated sheets of metal required in limited quantities are produced by the Cincinnati press brake shown in Fig. 3, which is also used for a large variety of forming on long metal sheets. In aircraft construction, corrugated sheets of aluminum alloy are used in combination with flat sheets for wings, floor supports, and other parts. For the quantity production of corrugated sheets, there has recently been installed the Kane & Roach roll-forming machine shown in Fig. 2.

This roll-forming machine is equipped with seventeen sets of rolls that shape the sheets to the desired contour and dimensions plus a number of rolls that "over-form" the metal to take care of spring-back after the sheets leave the machine. This provision is especially important when sheets of heat-treated aluminum alloy (24 SRT) are being handled, because that material is particularly springy. Every second set of the forming rolls is power-driven, the alternate rolls being idlers. The first four sets of rolls, which form the central corrugation of the sheets, are illustrated in Fig. 4 and the final set in Fig. 5.

In addition to aluminum alloy, sheets of stainless steel are regularly rolled with this equipment, the machine having a capacity for rolling stock up to 0.091 inch thick. The rolls are adjustable vertically to take care of different gages of material, and also horizontally. On the left-hand side of the machine illustrated in Fig. 2, the roll shafts extend beyond the housings, so that rolls can be provided on the overhanging shaft ends for bending the edges of the sheets to various sectional forms.

Close tolerances, for sheet metal, can be maintained. The loops or convolutions of the corrugations are ordinarily held within 0.015 inch of pre-



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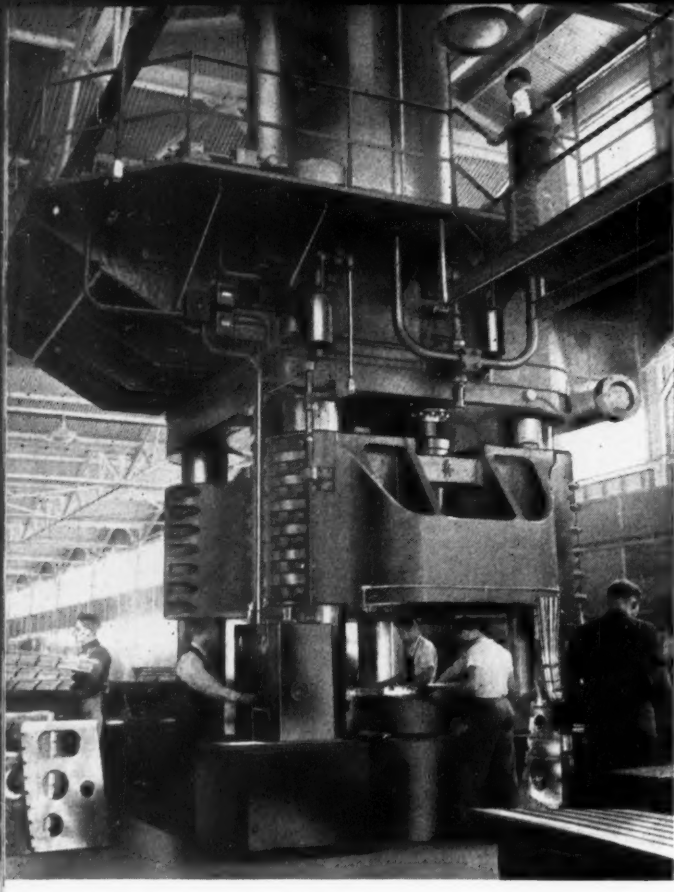


Fig. 1. 5000-ton Hydraulic Press Employed for Blanking, Piercing and Forming Sheet-metal Aircraft Parts by the Guerin Process

DOUGLAS BUILDS THE

scribed dimensions, and the tops of all loops are held in one plane within 0.010 inch. The over-all width of sheets is readily held within 0.060 inch, even though sheets as wide as 33 inches are rolled into corrugated sheets 22 inches in width. The over-all length of the machine is about 40 feet.

Flush rivets are being increasingly adopted in aircraft construction in order to cut down wind resistance to a minimum. Plane Models DC-4 and DC-5, two of the latest Douglas commercial planes, and the new Douglas attack-bombers are flush-riveted on all external surfaces. In Fig. 6 is shown a close-up view of an Erco beam type automatic punching and riveting machine which punches rivet holes through two or more sheets at a time, dimples the bottom sheet to accommodate the flush head, transfers the rivets from a magazine to the punched holes, and drives the flush rivet head.

The rivet holes are punched and dimpled by an air-operated ram that rises from beneath the sheets as an upper ram descends to push a hollow-end tool on top of the sheets. This hollow-end tool is contained in the left-hand arm of a swivel head beneath the upper ram of the machine. The punching and dimpling operation is effected by depressing a button on a floor switch. After the holes have been produced, the punch remains in the holes to hold them in alignment until the rivet is driven. While the punching operation is taking place, the right-hand arm of the swivel head receives a rivet from the magazine.

When the operator depresses a second button on the floor switch, the right-hand arm of the swivel head swings into line with the upper ram, which then descends and pushes the rivet through the holes, the rivet being headed flush with the under

Fig. 2. Roll-forming Machine Installed for the Quantity Production of Corrugated Sheets, the Machine Having a Capacity for Handling Sheets up to 33 Inches in Width

side of the work by the resistance offered by the receding punch. Both the upper and lower rams of the machine are air-operated.

Rivets with a flush head of 100 degrees included angle are used in Douglas operations. The magazine can be changed to suit the various sizes of rivets used, which range from 3/32 to 3/16 inch in diameter. Sheets of material being riveted together are supported on tables at the front and rear of the machine which are adjustable to suit the height of the work. The width between the housings of this riveting machine is 180 inches. At least twenty rivets can be driven per minute.

Various aircraft shops have developed methods for the high-speed milling of extruded sections of aluminum alloy. In Fig. 7 is shown a planer type of machine developed by Douglas engineers which is equipped with high-speed milling heads on both sides of the cross-rail. These heads can be fed in and out by pneumatically actuated cams to obtain various contours on the extruded shapes, and also up and down in accordance with templets attached to the front and back of the table. The heads are provided with rollers that ride on top of the templets, the rollers being held in close contact with the templets by air pressure. Right- and left-hand parts can be machined at the same time by the use of the two milling heads, one cutter performing climb-milling and the other conventional milling. The table can be fed in either direction.

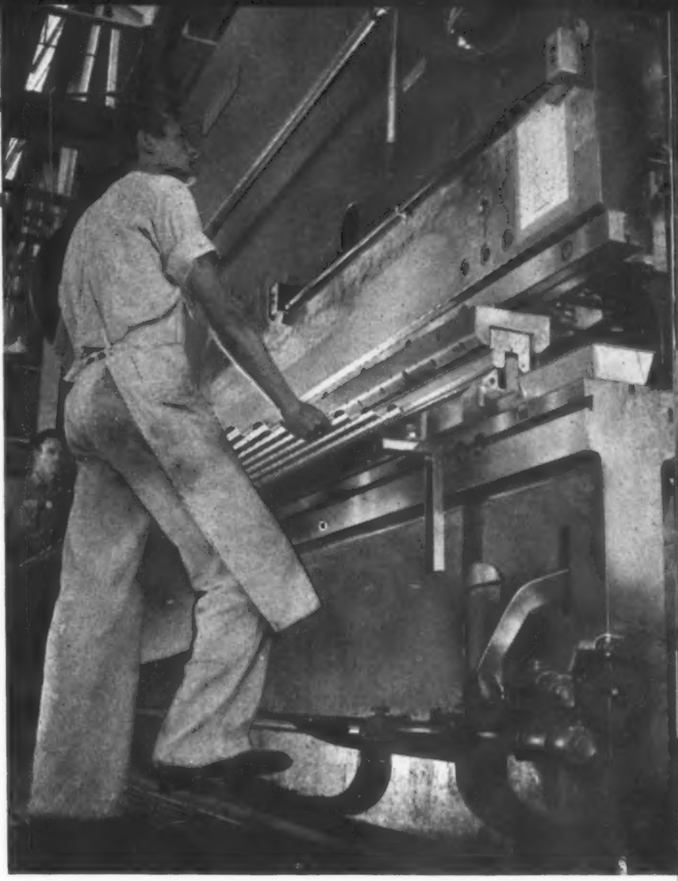


Fig. 3. Press Brake Employed for Corrugating Sheets in Limited Quantities and for a Variety of Other Work on Long Metal Sheets

The table is operated at speeds up to 25 feet a minute, being driven through chains by a Reeves variable-speed drive. Both cutter-heads are driven by separate 15-H.P. motors, the motor shaft in each instance being attached directly to the cutter-arbor. Speeds as high as 10,800 R.P.M. are used

Fig. 4. First Four Sets of Rolls that Produce the Central Groove in Corrugated Sheets

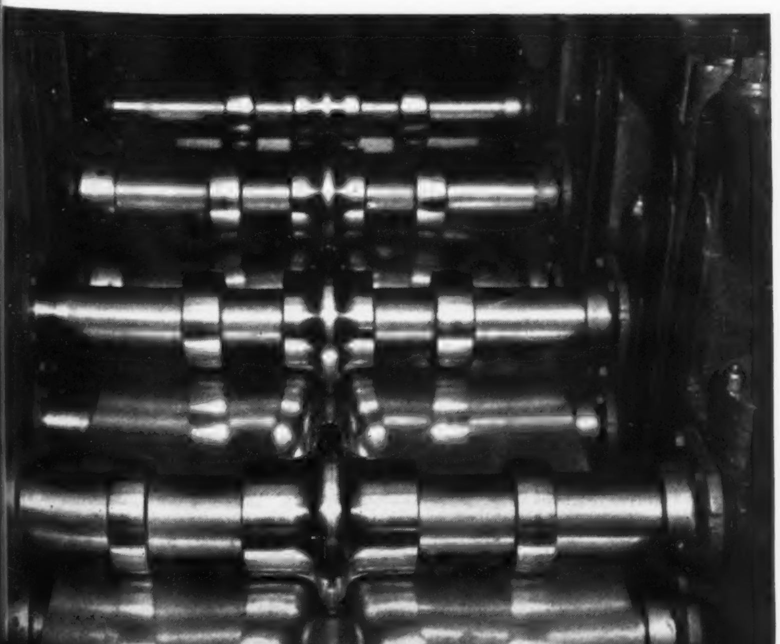
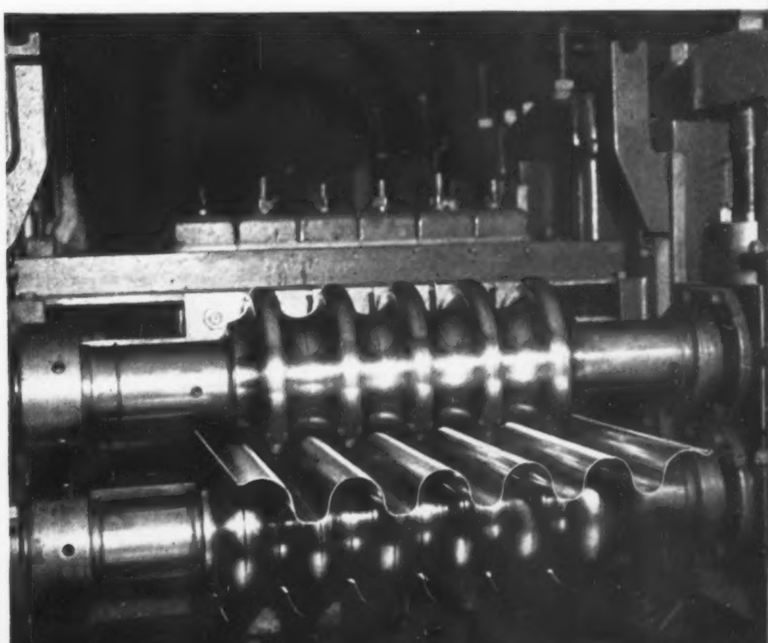
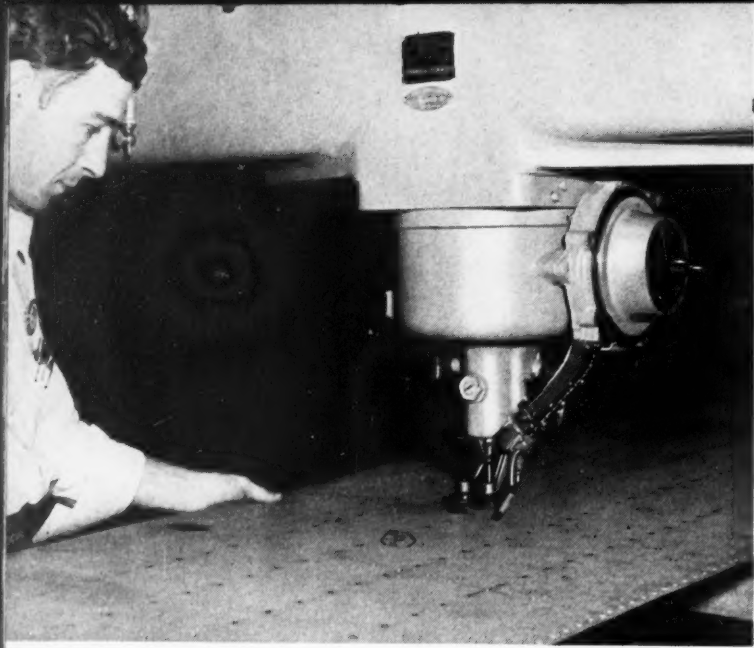
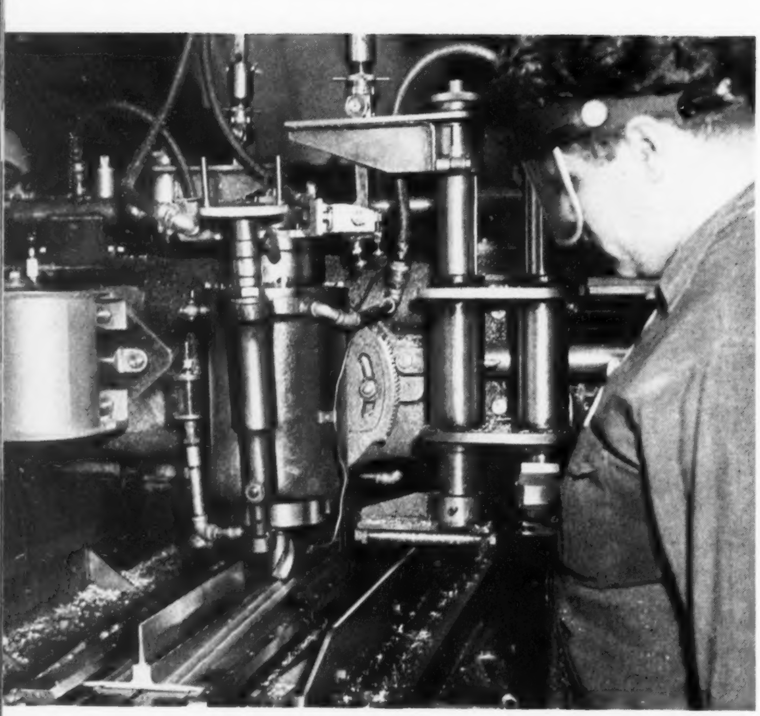
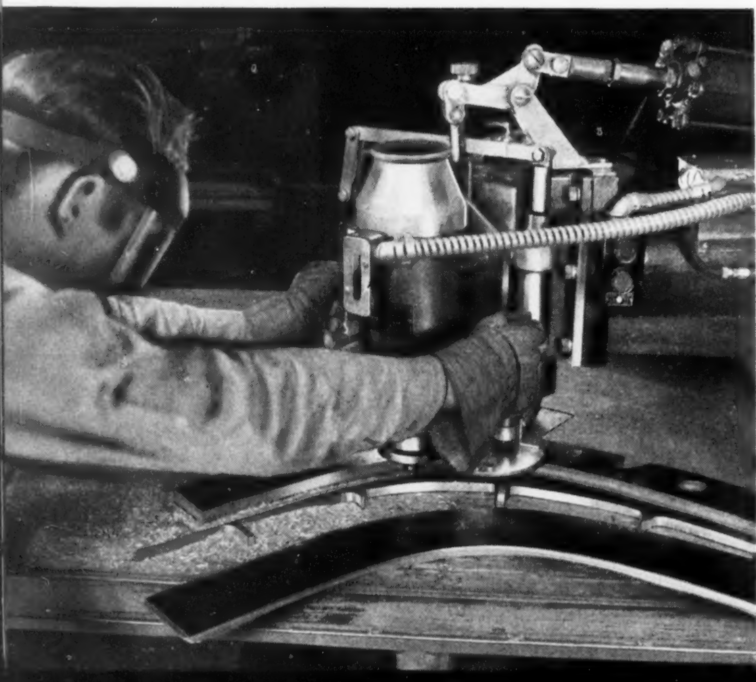


Fig. 5. Final Rolls of Corrugating Machine which Can Turn Out Sheets at 68 Feet a Minute









with the largest cutters, which are 1 3/4-inch diameter end-mills. Cuts as deep as 0.180 inch are taken the full length of the end-mills.

The cutter-heads can be swiveled for taking angular cuts in combination with concave and convex cuts obtained through the cams and templets. Any length of extruded section, such as used for the cap strips of wings, can be handled. The long extruded sections are held securely to the table by a series of twenty-eight air cylinders, which actuate individual bar type clamps that push the work against stops on the table.

Extruded shapes that become warped in this milling operation are straightened in a Hannifin 7 1/2-ton hydraulic press. Cap strips, for example, must be straight within several thousandths of an inch, even though they are as long as 35 feet, in order to fit into the jigs.

Routing operations are also performed at high speed, the routing spindles being driven at from 10,800 to 15,000 R.P.M. by direct attachment to motor armatures. Generally, ten sheets of material stacked to obtain a height of about 1 inch are routed at feeds up to 18 feet per minute. A typical operation of this sort is shown in Fig. 8. The routing heads are mounted at the outer end of hinged radial arms, 7 feet long. A single-lip cutter, of 5/16 inch diameter, is guided by a roller above the tool which rides along the edge of Masonite templets fastened on top of the sheets. These templets are located as close together as possible in order to hold scrap to a minimum.

Much of the machining work on precision and large parts is "farmed out" to machine shops in Los Angeles; but, even so, the Douglas company now employs nearly 1100 skilled machinists. Quite a few new machines have been installed in recent months, of which a number are shown here. In Fig. 9, for example, is shown a Heald "Size-Matic"

Fig. 6. (Top) Automatic Machine that Punches Holes through Sheets, Dimples One Sheet, Inserts Rivets, and Drives the Flush Heads

Fig. 7. (Center) Planer Type Milling Machine with Two Heads for the High-speed Milling of Extruded Shapes to Irregular Contours

Fig. 8. (Bottom) Routing Machines are Operated at Speeds up to 15,000 R.P.M. in Cutting Stacks of Sheets to Irregular Templets

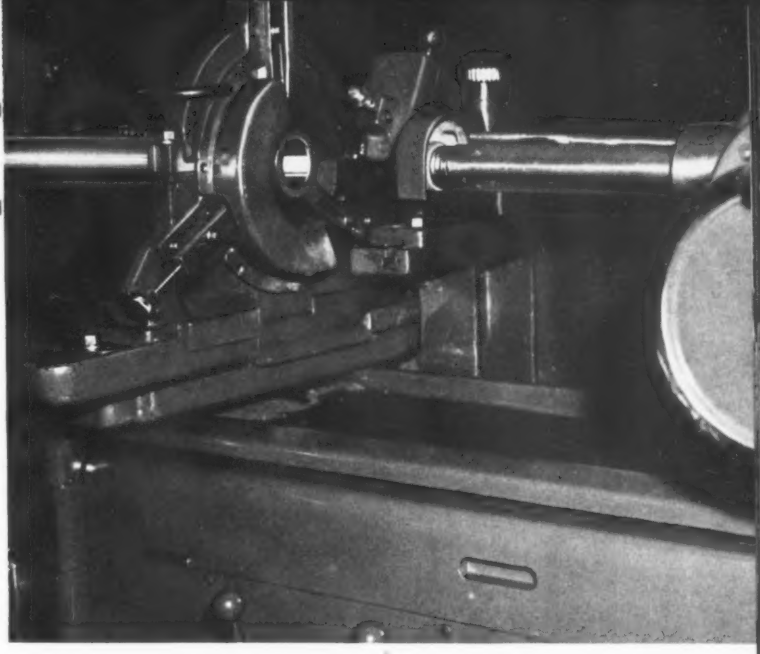
grinding machine finishing a retracting cylinder for a landing gear. These cylinders range up to 28 inches in length, and are ground to nominal sizes of about 2 3/4 inches in diameter. Tolerances are generally plus or minus 0.001 or 0.002 inch, but in some instances, they are as close as plus or minus 0.0002 inch.

Fig. 10 shows a Bakewell tapping machine which is designed for production tapping to the Class 3 fit required on aircraft parts. The outstanding feature of this machine is the provision of a lead-screw for controlling the feed of the tap and, therefore, the lead of the thread cut in the work. This lead-screw is engaged by two threaded plugs on opposite sides which remain in one position and thus control the down feed of the tap. The threads on these lead control plugs are cut by means of the upper end of the lead-screw, which is fluted and ground to form a thread hob. The threads are cut by merely feeding the hob portion of the lead-screw down across the plugs. The lead control plugs can be rethreaded at any time, and new plugs can be threaded just as easily.

Typical work tapped on this machine includes landing gear parts, retracting struts, control brackets, hydraulic valve parts, and so on. In the particular operation illustrated, a 1/8-inch pipe tap is threading a hole in the end of a strut.

The Norton cylindrical grinder shown in Fig. 11 is used for finishing external surfaces on various parts, including retracting cylinders, tail-posts, and hydraulic pistons. The particular operation illustrated consists of grinding the shaft for a landing gear retracting link. This shaft was 32 inches long and had to be ground to from 2.184 to 2.185 inches in diameter.

Additional operations and equipment employed in building airplanes in the Douglas plant will be described in a coming number of MACHINERY.



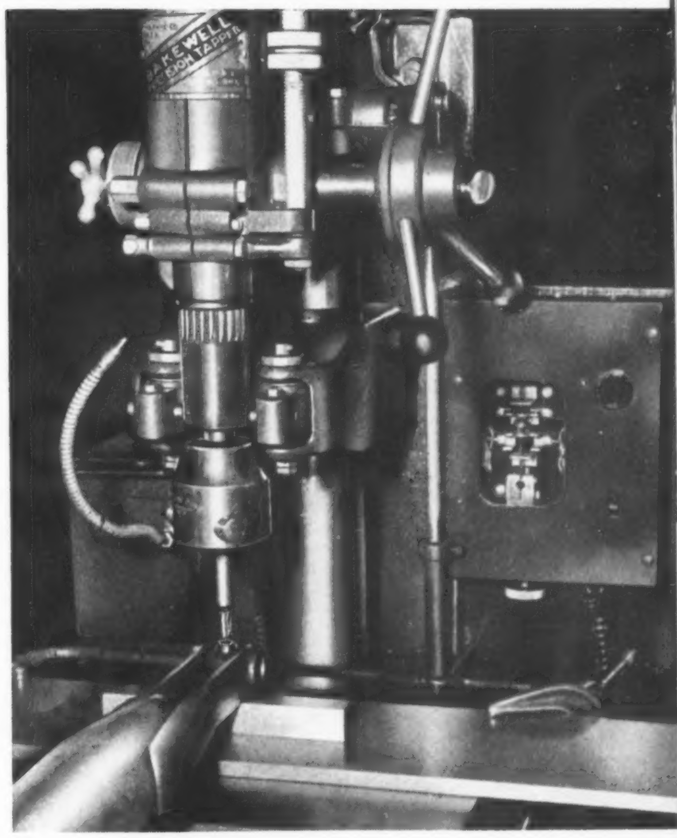
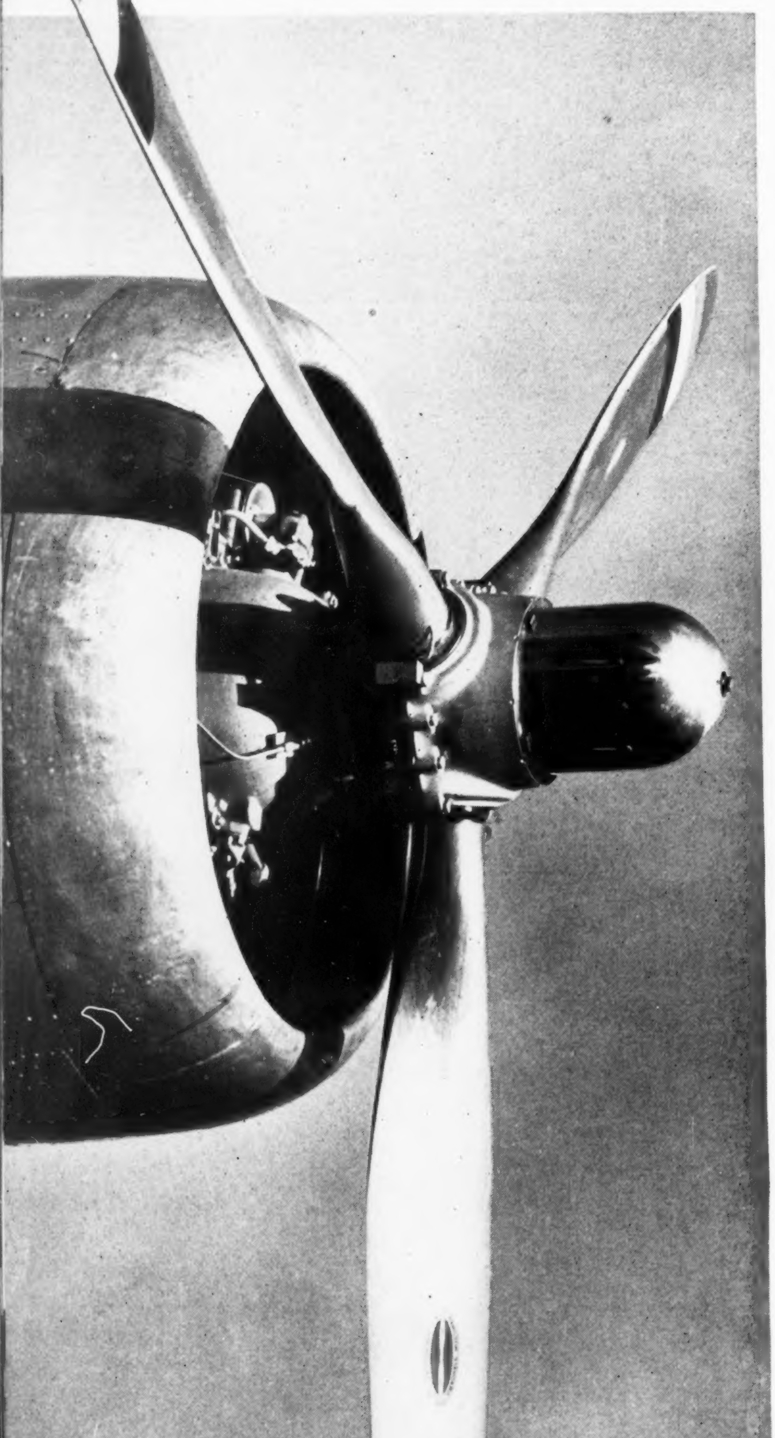


Fig. 9. (Top) Grinding a Bore that Extends the Full Length of a 28-inch Retracting Cylinder for a Landing Gear

Fig. 10. (Center) Tapping Machine with Lead-screw that Insures Holes Tapped to Class 3 Fits in Production

Fig. 11. (Bottom) The External Surfaces are Ground on a Variety of Parts on This Cylindrical Grinding Machine

Outstanding Methods Produce



NOTEWORTHY contributions made to aviation through the progressive development of aircraft propellers from the original one-piece wooden types to the Hydromatic quick-feathering, constant-speed propeller, have established an enviable reputation the world around for Hamilton Standard Propellers, Division of the United Aircraft Corporation, East Hartford, Conn. Paralleling these advances in propeller design has been just as striking progress in manufacturing procedure. Skilled machinists and standard machine tools were necessary for all operations in propeller manufacture in the early days of the industry, whereas today the extensive use of automatic and semi-automatic machines enables even more accurate propellers to be manufactured with semi-skilled labor.

Recent months have witnessed the installation of many new machine tools in this plant. Some of them are of special design, developed to give the high production demanded today from our busy airplane plants. Other machines of latest standard types are being applied in special and conventional ways. Outstanding operations in this highly mechanized propeller plant are described in this article.

Perhaps the most unusual machine in the factory is the large multiple-head rotary type of machine shown in Fig. 1, which was built by the Barnes Drill Co. for drilling and reaming the taper hole in the shank end of propeller blades. The machine has five hydraulically actuated tool-heads, which are fed vertically upward between indexings of an overhead work-carrier. Loading of the propeller blades is facilitated by the use of a 500-pound electric hoist running on an overhead track.

Three wrenches driven by an electric motor are provided at the loading station illustrated in Fig. 2 for clamping the shanks of the propeller blades in the six chucks mounted around the carrier. These wrenches are raised into engagement with bolt heads on the lower side of the chuck units as a foot-treadle is depressed by the operator. When a chuck is indexed into the loading station and the wrenches are raised they revolve from right to left for loosening the chuck jaws to enable the finished propeller to be removed. Then the next time that the wrenches are actuated, their rotation is automatically reversed for tightening the bolt heads and clamping a new propeller blade that has just been loaded into the chuck.

Hamilton Standard Propellers

By
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Propellers Division
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craft Corporation

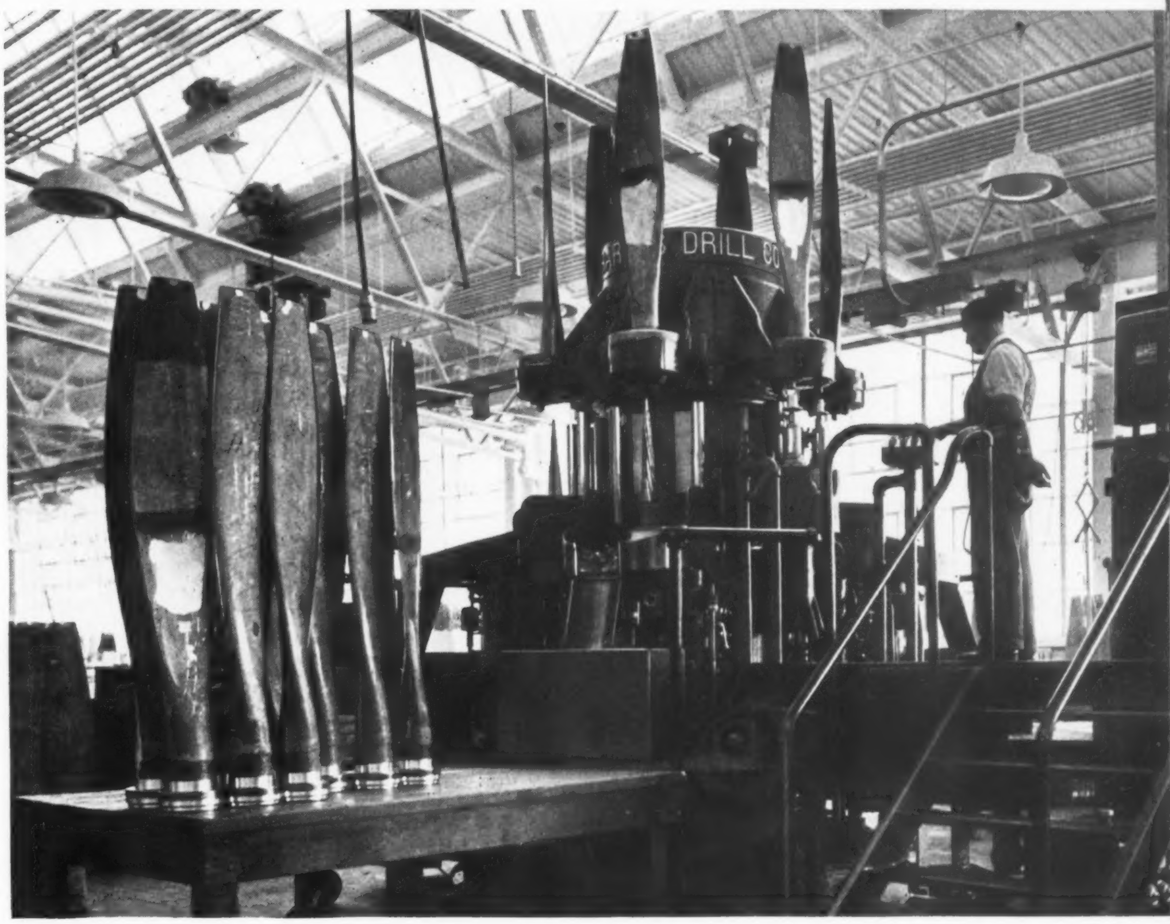


Fig. 1. Large Indexing Type of Machine with Five Hydraulic Tool-heads for the Automatic Drilling and Reaming of the Taper Hole in Propeller-blade Shanks

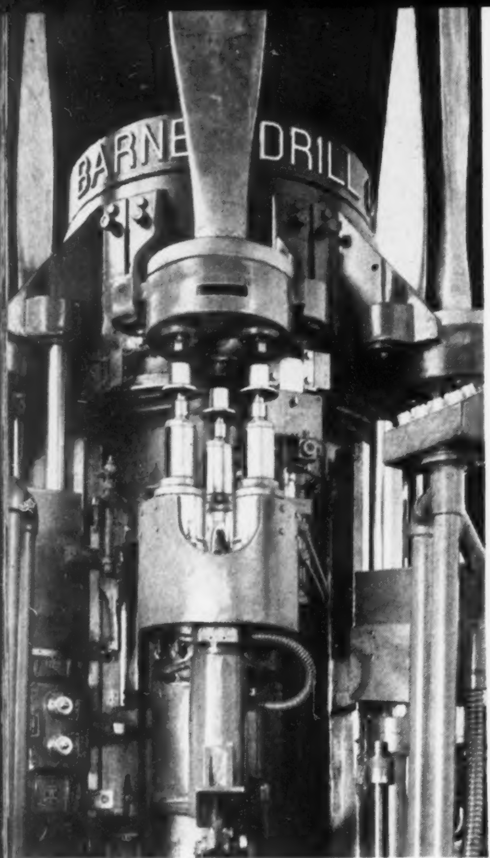
The propeller blades are indexed from left to right around the machine. In the first three working stations, where rough-reaming and tip-drilling occur, the tool-heads feed up in one pass, but in the finishing stations, they feed up and down several times in the "step drilling" manner during each operation so as to allow the chips to fall free of the tool.

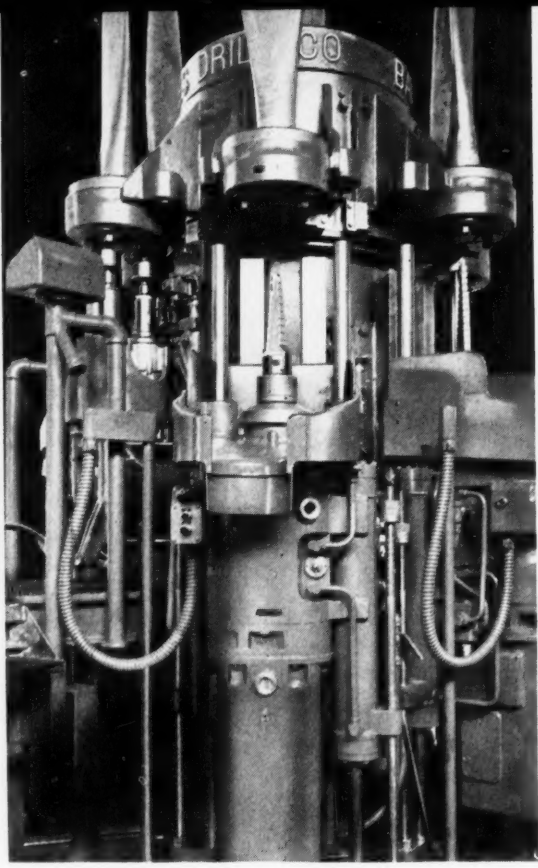
Rough-reaming of the taper hole occurs in the first working station, which is illustrated in Fig. 3, after which follow drilling and reaming operations with the tools seen in Figs. 4 to 7, inclusive. Each of these tools has a hole drilled the full length to the point for delivering coolant into the blade hole during drilling or reaming. When completed, the taper hole is approximately 18 inches deep by 4 inches in diameter at the open end.

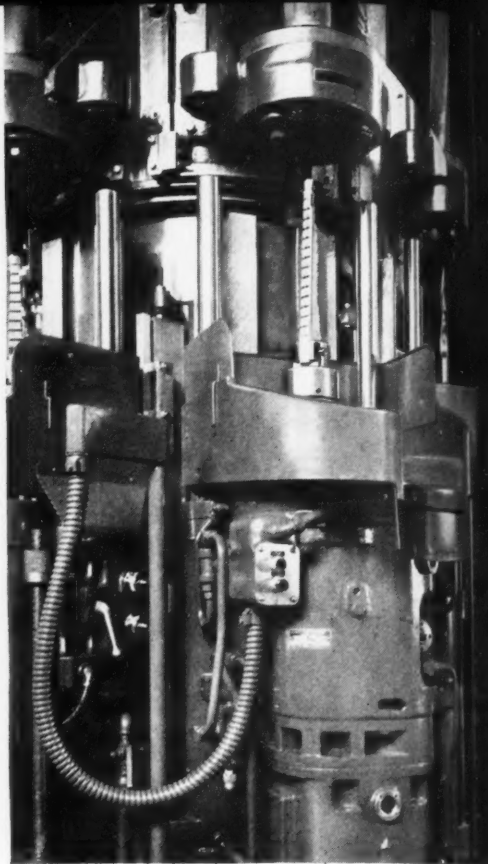
The operator keeps a close check on each machine cycle through a panel board at the right of the loading station. Five red lights go on as the tool-heads start their upward cycle, and these lights go out individually as the corresponding heads complete their upward feed and return to the starting position. When all the red lights have gone out, a white light goes on to inform the operator that the head movements have been completed. The operator then pushes an electric button to index the work-carrier. Two guide bars on each tool-head enter piloted bushings on the various stations of the carrier to insure correct location of the propeller blades for each step in the cycle.

The operations performed by this machine were previously done on a single-spindle machine by changing tools between successive movements of the work-slide to and from the tools. The new multiple-head machine finishes the propeller blades in one-tenth the time previously required.

A machine of special design built by the Heald Machine Co. for turning the hub end of propeller blades is shown in Fig. 8. The photograph was taken from the back of the machine, so as to show the three tool-slides, which are hydraulically actu-







Figs. 2, 3, and 4. Loading and First and Second Working Stations of the Propeller-blade Drilling and Reaming Machine Shown in Fig. 1

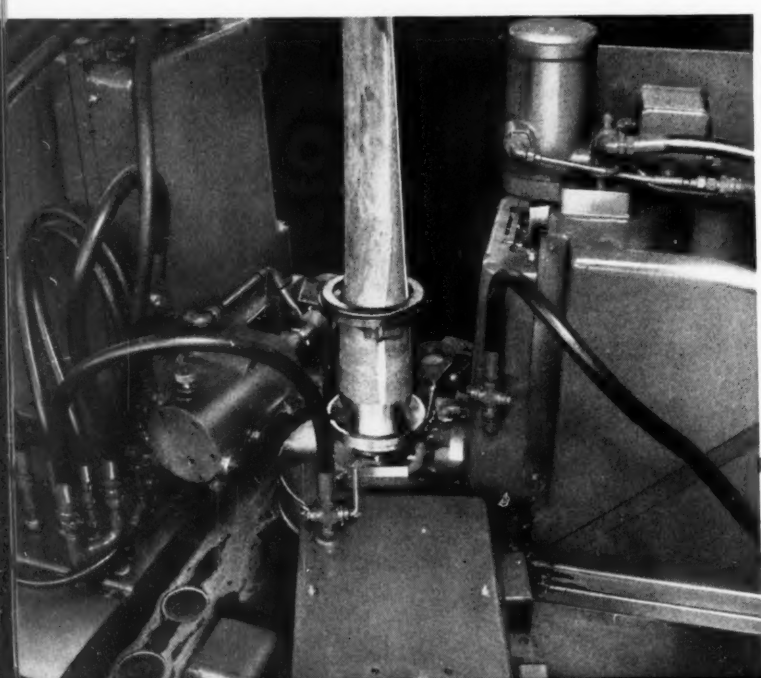
ated to and from the work. The tool-head seen at the left moves forward to the work and then feeds downward under a cam control to turn the taper. The slide then stops and the tool-arbor swivels on its axis for turning the large fillet that joins the shank portion to the flange. At the same time, the tool-slide at the right goes through a combined angular and vertical movement for turning two straight surfaces on the flange and beveling two edges. While these slides are in action, the slide seen in the foreground moves forward at an angle for facing the bottom of the flange.

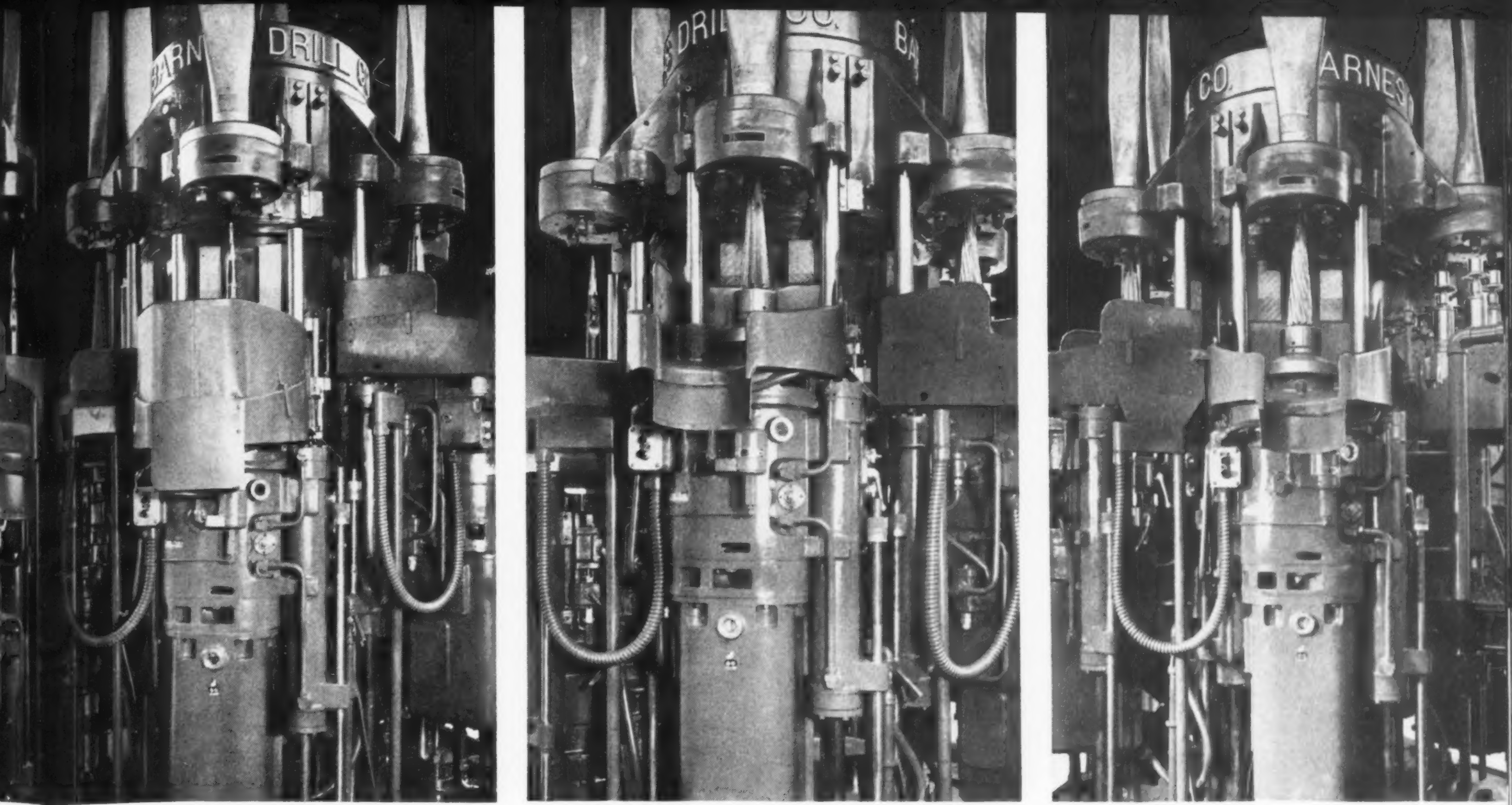
An eight-station Mult-Au-Matic equipped for machining stationary propeller cams is illustrated in Fig. 10. This machine is double-indexed, so that the cams can be machined from both ends in two passes around the machine. In the first pass, the cam is loaded with the flange at the top, and in the second pass, with the flange at the bottom.

In the first working station, during the first pass around the machine, the flange of the cam is turned, faced, and counterbored by the tool-head seen at the right. There are two tool-heads in the next station to which the part is indexed—the second station from the left—one of which is fed horizontally after it has been lowered to the desired position, for under-cutting the back face of the flange, facing the front of the flange, and chamfering the front edge. The tools on the second head feed straight downward for turning an internal shoulder. Similar tool-heads in the next working station again under-cut the back face of the flange, finish-face the front of the flange, counterbore to size, cut a groove in the flange face, and turn the flange.

The first working station to which the cam is indexed in the second pass around the machine is seen in the center of the illustration. Tools on the head in this station turn the body of the cam for one-half its length, chamfer the outside surface at the top, bore the cam for one-half its length, and counterbore the upper end. In the second working station, seen at the extreme left, the boring and

Fig. 8. Special Machine Designed with Three Tool-heads for Taking Turning and Facing Cuts on Propeller-blade Shanks





Figs. 5, 6, and 7. Tooling Provided in the Third, Fourth, and Fifth Working Stations of Propeller-blade Drilling and Reaming Machine

turning cuts are completed. The turning tools are ground to a radius, so as to correctly finish the fillet where the body joins the flange.

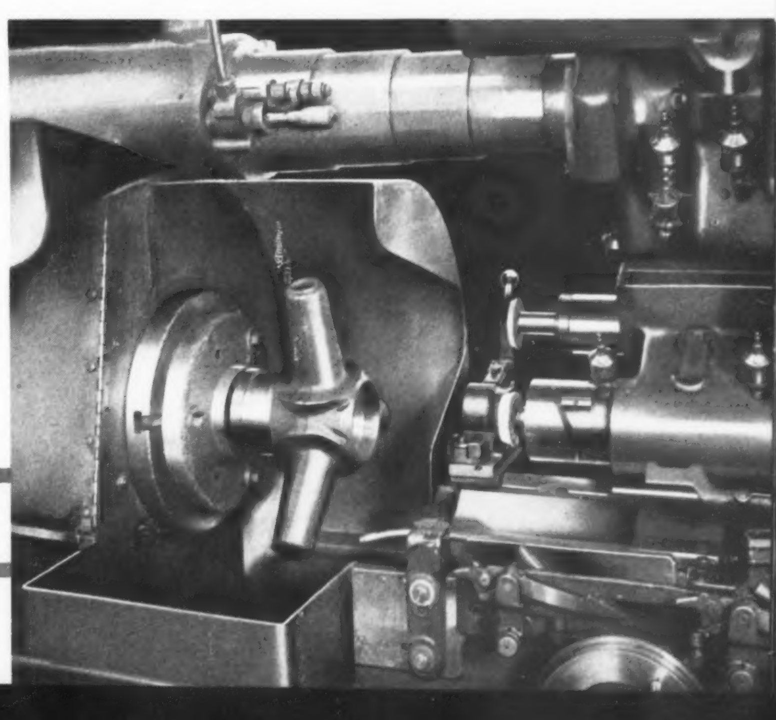
In the third working station the cam is finish-turned and finish-bored the full length, finish-counterbored at the upper end, and finish-faced on the internal shoulder. At the same time, a tool operated by a cam rack cuts a groove above the internal shoulder. When the cams leave this machine, they have been finished all over, stock to a thickness of 0.020 inch being left on each surface for removal by grinding. Gages for proper setting of the various tools are permanently mounted on swinging brackets such as seen on the tool-heads.

Fig. 9 shows a Bryant chucking grinder used for grinding a 15-degree seat in one end of the main bore of Hydromatic spiders, and a 30-degree seat in the opposite end. Both of these operations are performed in one machine by the use of two separate grinding spindles and by turning the work end for end on the arbor.

One of the final operations on the spiders consists of superfinishing two bearings on each arm. This operation is performed on the Foster machine illustrated in Fig. 11. The part is revolved slowly between the centers while the two-stone abrasive head is oscillated in a horizontal plane, with one stone riding on each bearing. The abrasive stones are free-floating in all directions.

A Natco opposed-spindle machine for drilling and reaming about twenty lightening and cam-slot holes in cams for Hydromatic propellers is shown in Fig. 12. A particularly interesting feature of this operation is the provision for indexing the work eight times. At the rear of the arbor on which the cam is mounted is a large disk with radial lines painted in black or white on different-colored segments. These "graduations" are lined up successively with a small V-prong or "gun sight" for locating the work correctly for drilling the various holes. The work is moved laterally and radially into the drilling positions by a pin which extends through the work and a cam spindle. The

Fig. 9. Chucking Grinder with Two Wheel-spindles for Finishing Angular Seats at Opposite Ends of Propeller Spider Bores



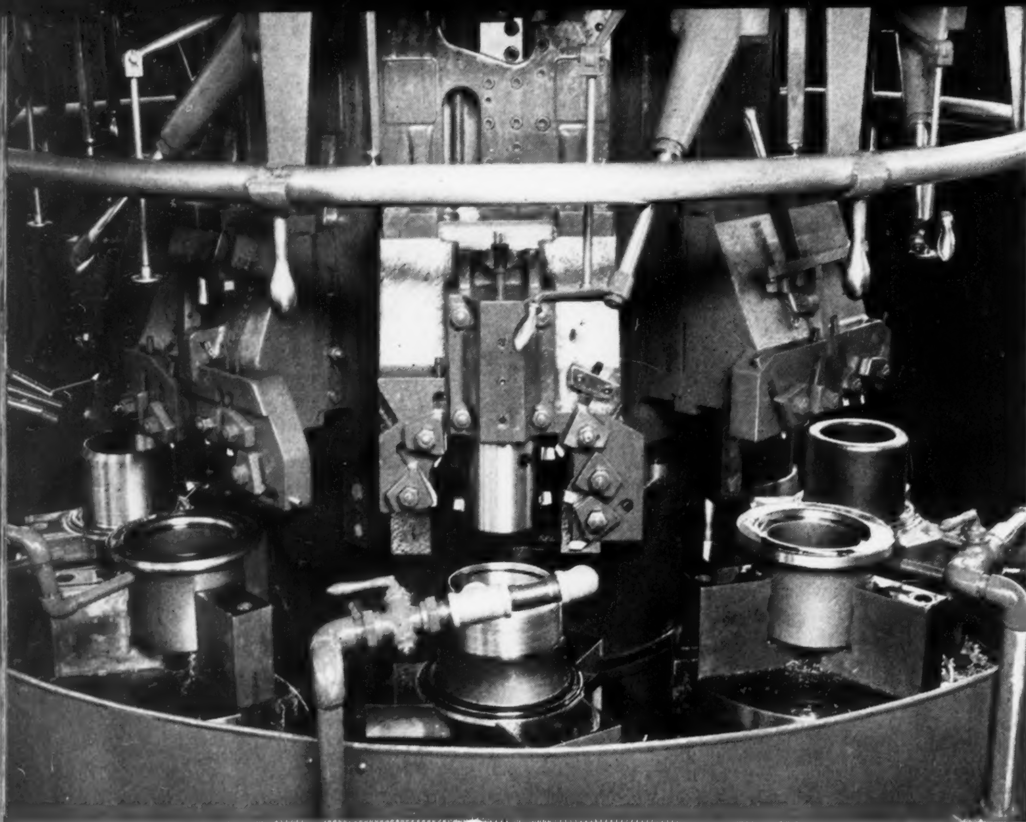


Fig. 10. Mult-Au-Matic Arranged on the Double Indexing Principle for the Complete Boring and Turning of Stationary Cams in Two Passes around the Machine

tools are interchanged to suit the different sizes of holes to be drilled and reamed, and the tools are provided with their own bushings. The tools and bushings are painted in accordance with the stations of the painted disk with which they are applied.

A Sundstrand opposed-spindle machine employed for milling four cam tracks in the rotary and stationary cams is shown in Fig. 14. The work is mounted on an arbor that is swiveled and moved forward during the operation by a master cam at the back of the machine. When two opposite slots have been milled, the work is indexed the required amount for milling the remaining two cam slots. Two cutters are used for simultaneously milling each slot on both sides. The slots are started from a drilled hole.

The cam slots are accurately ground all around their contour in the special Heald machine shown in Fig. 15. This machine is provided with a work-spindle that is positioned at an angle, as shown, to suit the cam being handled. In an operation, the cam is swiveled on its axis, and at the same time, is moved up and down in relation to the grinding

Fig. 11. The Two Bearings of Each Spider Arm are Given a High Degree of Finish in This Superfinishing Machine

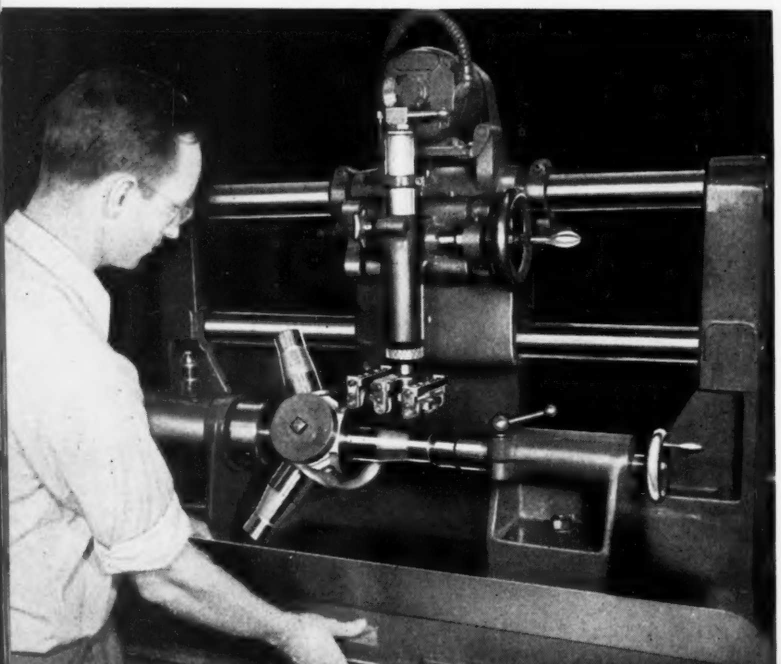
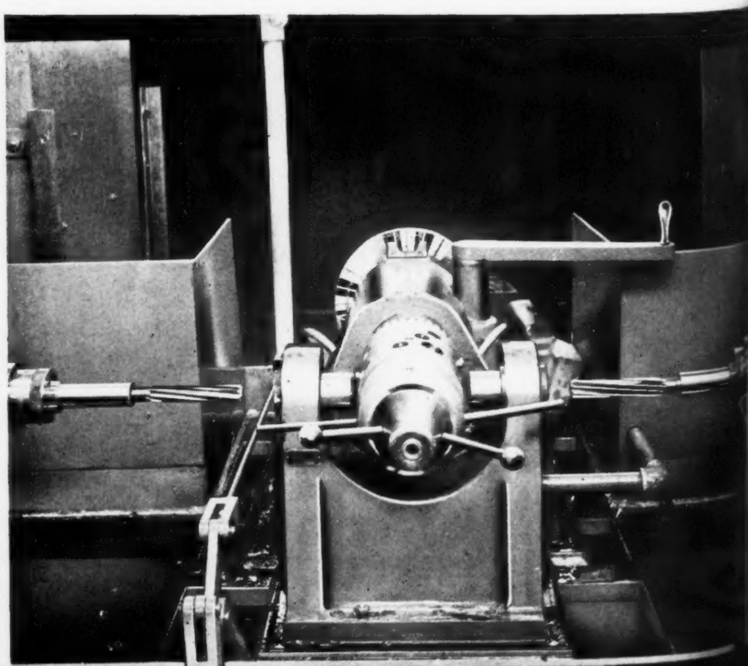


Fig. 12. A "Gun Sight" Insures Drilling Lightening and Cam-slot Holes in Proper Location around Propeller Cams



wheel, so as to carry the entire contour of the cam slot around the wheel. The up and down movements of the work-table are effected through a master ring cam at the bottom of the table unit. The grinding wheel merely oscillates back and forth in a horizontal plane.

Provision is made for indexing the cams to enable the four slots to be ground in one set-up of the work. The complete operation of the table, including indexing, and the traverse of the wheel-head are accomplished hydraulically.

The Lapointe hydraulic broaching machine shown in Fig. 13 is used for cutting away the inner edge of eight holes in gear segments, so as to form slots. This operation is performed in a single pass of the eight-broach tool. A pulling head in the base of the machine pulls the tool downward through the work. In operation, a gear segment is loaded on the fixture as shown, and the overhead broach slide then moves the broach downward until it connects automatically with the pulling head. As the broach is pulled through the work, it is automatically disconnected from the upper slide, so as to permit the work to be removed from the table when the operation is completed. At the end of the operation, the pull-head raises the broach until it is again connected with the upper slide, after which this slide withdraws the broach through the fixture, and it is automatically disconnected from the pull-head to permit loading. Engineering specifications necessitate that these slots be produced within a tolerance of 0.0005 inch. The equipment used not only meets this requirement, but does so in minimum production time.

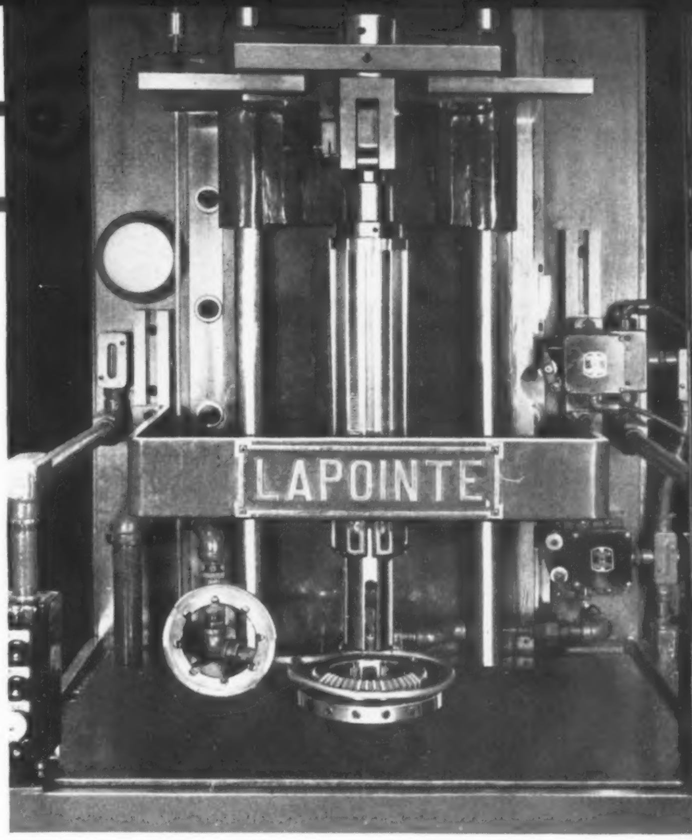


Fig. 13. Machine Employed for Broaching the Inner Edge of Eight Holes in Gear Segments to Form Slots

Additional operations performed in the Hamilton Standard propeller plant will be described in a second installment of this article to be published in a coming number of MACHINERY.

Fig. 14. Opposed-spindle Milling Machine Employed for Cutting Four Cam Slots around Propeller Cams

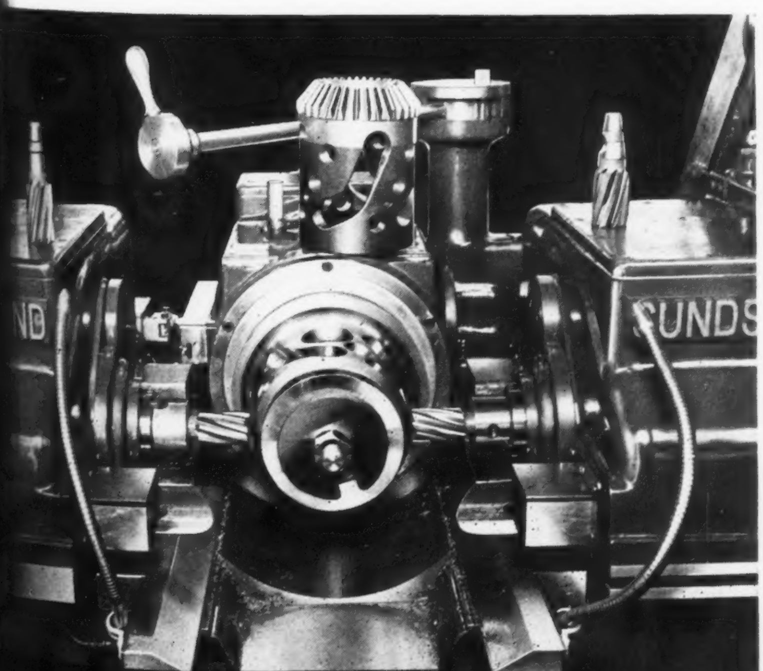
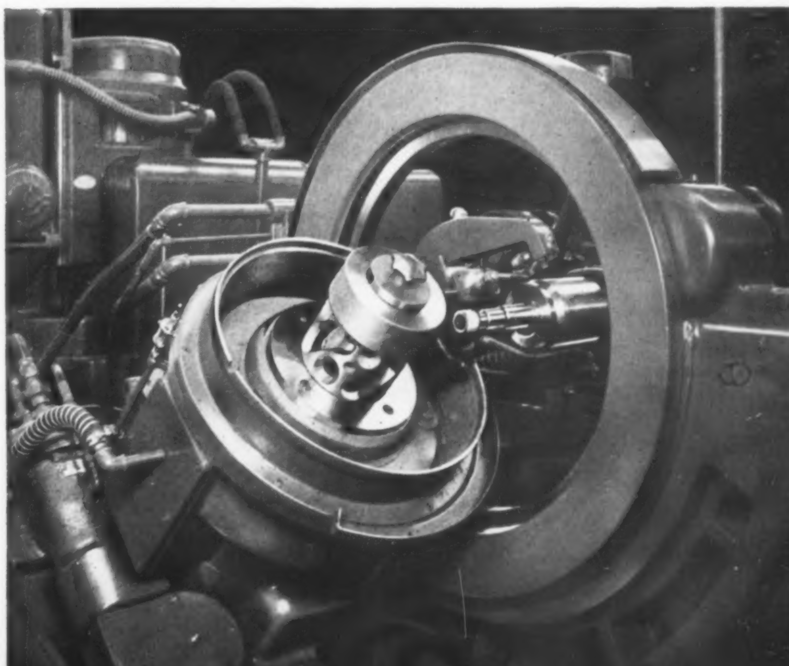


Fig. 15. Unusual Grinding Machine that Accurately Finishes the Entire Contour of the Four Cam Slots



Boeing Specializes on Four-Engine

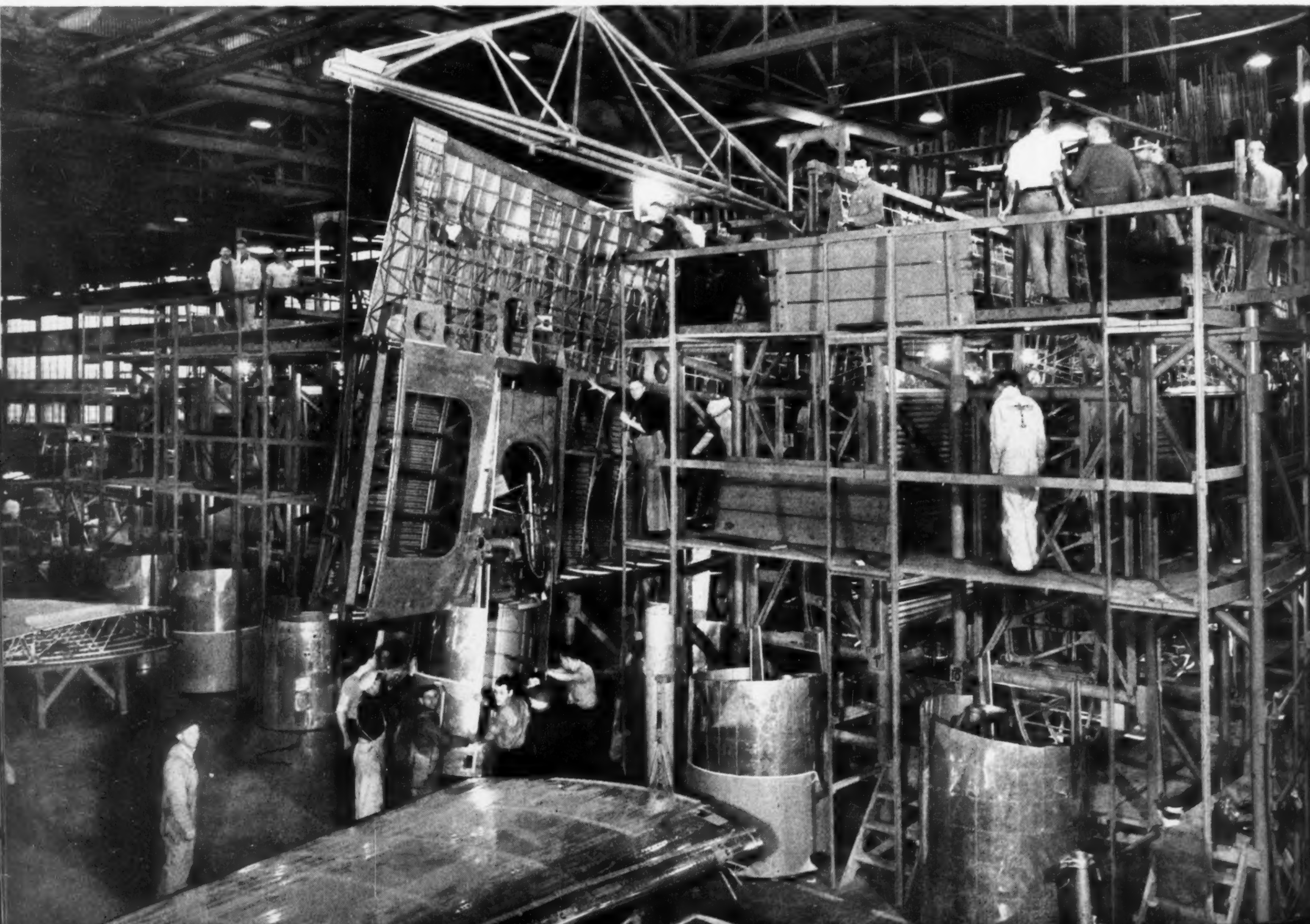
WITHIN the last five years, the Boeing Aircraft Co., Seattle, Wash., has become noted for the building of huge airplanes. Today, this concern specializes on three types, all of which are equipped with four radial type, air-cooled engines. The wing span of these huge planes ranges up to 152 feet.

The first of these big planes, brought out in 1935, was the prototype of the United States Army's Flying Fortresses. These bombers have a wing span of 103 feet 9 inches, a length of 67 feet 10 inches, and a maximum weight of over 45,000 pounds. Two years ago, the first Boeing Pan-American Clipper was built with a wing span of 152 feet, a length of 106 feet, and an over-all height of 27 1/2 feet—actually bigger than the largest of Columbus' ships. The Clippers have a gross weight of 82,500 pounds, and carry seventy-four passengers and a crew up to fifteen.

The "Stratoliner" is a land plane developed within the last two years for flying in the smooth air region of the sub-stratosphere at elevations between 14,000 and 20,000 feet above sea level. This plane has a wing span of 107 feet 3 inches, a length of 74 feet 4 inches, and a height of 20 feet 9 inches. The gross weight is 45,000 pounds, and the plane can carry thirty-three passengers and a crew of five. Three of these giant transports have already been built for the international routes of Pan-American Airways, and five of them for the coast-to-coast service of Transcontinental & Western Air, Inc. Comfortable high-altitude flight is made possible in the Stratoliner by engine-driven superchargers which automatically increase the density of thin air to that of normal low-level atmosphere as the plane climbs higher and higher.

In turning out such fascinating products, there are numerous operations of great interest that differ widely from the methods used in other industries. Some of these operations are described here.

In common with general practice in building airplanes, the wings, stabilizers, and other sections are assembled at the Boeing plant in jigs constructed of structural steel which are surrounded by wooden scaffolding to enable the workmen to reach the various parts being riveted together.



Planes

By CHARLES O. HERB

Some of these jigs are as high as 30 feet and range up to 100 feet in length. One of these huge jigs is shown on page 158. In view of these large dimensions, provisions have been made for adjusting the upright members prior to starting each job, in order to compensate for any changes due to temperature variation or settling of the floor and thus insure accurate alignment.

All the vertical uprights are mounted on screw-jacks, as may be seen in Fig. 4, and a level mark is scribed on each upright in accurate relation with level marks on all the other upright members. Before the assembly of a wing section, fuselage, or nacelle is started, all these level marks are checked with a surveyor's transit, as shown in the illustration, and necessary vertical adjustments are made through the screw-jacks. The man at the left is shown holding a flashlight on a level mark to facilitate sighting by the transit man. When these men have completed their inspection of a jig, the level marks must be in the same plane within 0.005 inch in many instances, and 0.010 inch in others.

Much of the production equipment found in an airplane-building plant is employed in forming sheet metal or structural shapes, such as tubing and extruded aluminum-alloy bars. A machine developed for applying the tube-bending principle to extruded bars or sheet-metal strips is illustrated in Fig. 1. This machine is equipped with a 15-foot table, on which is bolted a wooden or Masonite form to which work is to be bent. The flat stock is clamped to this form at one end, as seen in the illustration, and is gradually bent to the contour of the form by a rubbing block attached to the pneumatic ram seen at the left.

In the particular operation illustrated, a straight piece of sheet metal previously formed on a press brake to a channel cross-section, with wide flanges at the open end, is being bent to a large radius. The channel portion of the stock fits into a wide groove in the form and the flanges rest against surfaces above and below the groove. The rubbing block fits into the channel and against the flanges.

The pressure applied to the rubbing block can be varied to meet individual conditions, and the rotary speed of the table can be regulated through a variable-speed drive. The table can be operated in both directions, and the rubbing block applied both in

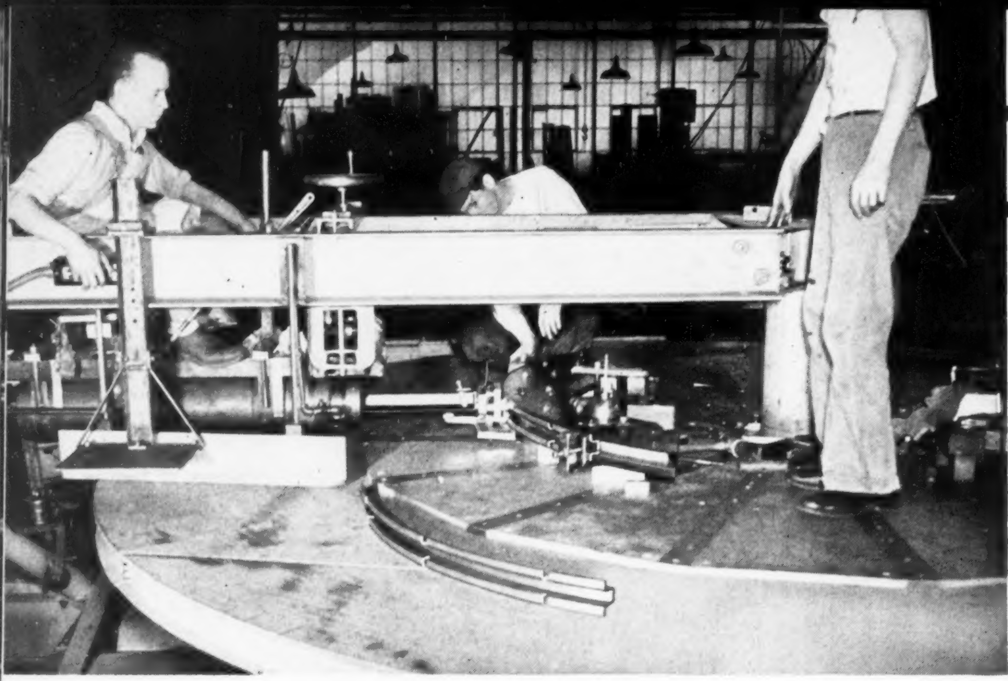


Fig. 1. "Wrapping" Machine Employed for the Forming of Structural Shapes and Sheet-metal Strips to Various Radii and Irregular Contours

the forward and reverse movements. The pneumatic ram is suspended from an I-beam support that extends to the center of the table, and the ram can be adjusted to various angles with respect to the plane of the table and the table center.

Work has been "wrapped" on this machine from sections of stainless steel, chromium-molybdenum steel, and aluminum alloy. The rubbing block is made of Masonite, cast iron, or steel, depending on the material being worked. A typical circular track formed on this machine from a chromium-molybdenum-steel section to a diameter of 28 inches was accurate within 0.006 inch.

Draw-formers are also used for forming long pieces of sheet metal or extruded shapes to arcs or irregular contours. In such operations, the form is mounted on one side of the bench, as seen in Fig. 2, and a rubbing block is pulled along the front of the work to force it against the form. The draw-former illustrated is 20 feet long.

Drilling of the multitudinous rivet holes required in aircraft building is facilitated at the Boeing plant by the use of traveling drill heads which can be moved back and forth over long work. In Fig. 3 typical equipment of this type is seen arranged to run along tracks mounted on the sides of a wing-spar jig. The Craftsman drill head is pivoted on its carriage, so that it can be swung around an arc for drilling holes located anywhere on jig templets fastened above the work. The drill carriage has a span of approximately 4 feet, the length of the jig tracks being about 50 feet.

An interesting feature of these drilling operations is that the various templet holes are sur-

Fig. 2. Draw-former for Bending Sheet-metal Strips and Extruded Shapes to Curved Forms

Fig. 3. Drilling a Wing Spar with Traveling Equipment Mounted on Jig Tracks

Fig. 4. Alignment of Jigs Used in Assembling Wings, Fuselages, etc., for Huge Planes is Periodically Checked with Surveyors' Instruments

rounded by circles painted in different colors in accordance with the sizes of the holes to be drilled through them. Circles of blue, red, and white, for example, denote three different sizes of holes, and the operator knows at a glance what the sizes are.

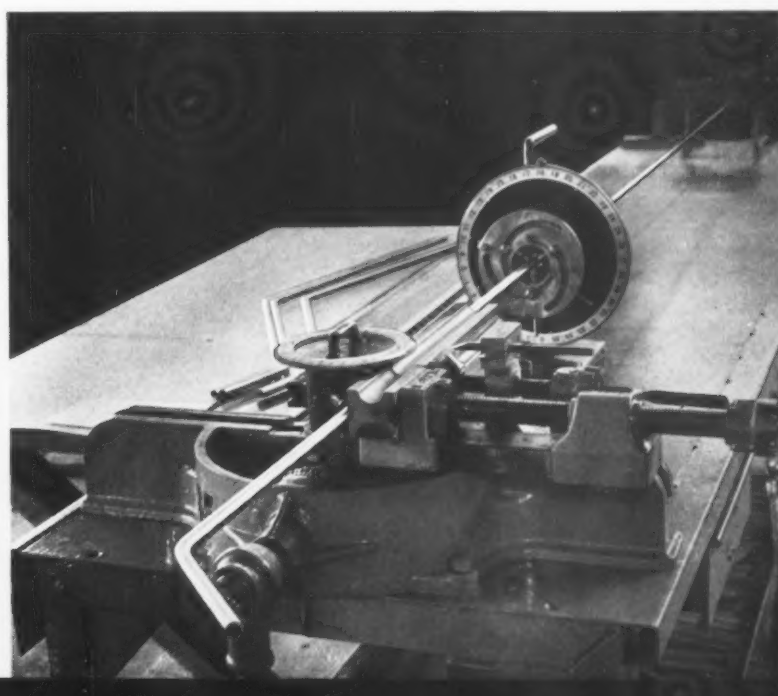
Larger airplane sections are similarly drilled by the use of the gantry drill seen in Fig. 7, which is arranged to run on a track 24 feet wide by 100 feet long. The drill head can be moved sidewise on its carriage, which has a width of about 6 feet, and the carriage can be moved back and forth the full width of the gantry structure. The latter can, of course, be operated the full length of the 100-foot track. Jigs located on the floor between the track rails are served by this equipment, it being the practice to prepare work in several jigs while work is being drilled in jigs previously loaded. Large bulkheads and center-section spans are typical assemblies drilled with this equipment.

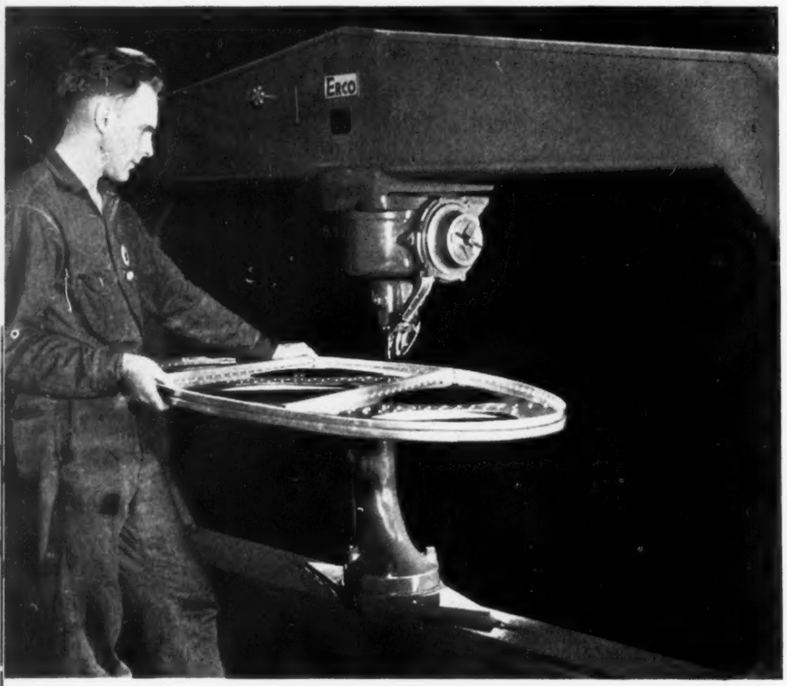
Corrugations from 1/2 inch to 1 3/4 inches deep are formed in sheets of duralumin 24 ST and 24 SRT on the Cincinnati press brake shown in Fig. 5, the same machine also being applied for a wide variety of forming work. In the corrugating of sheets, the customary practice is to hold the pitch of the corrugations to specified dimensions within an accumulative error of 0.020 inch in ten pitches. Sheets up to 16 feet long can be handled between the housings of this machine. The ground punch and die members employed are adjustable up and down, as well as sidewise, in their holders.

Parker tube-benders equipped with angle-indicating attachments or protractors that facilitate the making of bends in various planes with respect

Fig. 5. Typical Corrugation Forming Operation on a Power Press Brake

Fig. 6. Tube-bending Machine Equipped with Angle-indicating Attachments





to each other find extensive use. One of these hand-operated machines, employed on a typical operation, is shown in Fig. 6. The rear end of the tube is fastened to one of the protractors, which is mounted on a carriage that runs along the center of the bench, the protractor sliding on a mandrel bar. The mandrel bar extends from the far end of the bench to the bending blocks, so as to support the tube from the inside and thus prevent collapsing of the wall.

Bends are made by gripping the tube between stationary and movable blocks having grooves of the required dimensions to suit the tube, and then operating a ratchet wrench at the front of the machine to swing the movable bending block about its pivot. By observing the graduations on the dial of the protractor fastened to the bending block, the operator can readily determine when to stop bending. For the next bend, the operator loosens the right-hand bending block or jaw, pulls the tube through the bending blocks the required distance between the points of tangency of the bends, adjusts the protractor on the rear end of the tube if the next bend is to be made in a different plane from the first, reclamps the right-hand bending block, and proceeds as before.

Charts are kept of all bending operations to be performed in quantity, so as to permit quick duplication of bent tubes. A scale extends the length of the table in the center, so that the operator can readily determine the correct positions of the protractor carriage for various bending operations.

One of the latest machines to be installed in the Boeing plant is the Erco automatic punching and riveting machine illustrated in Fig. 8, which is employed for a wide variety of work that can be taken to the machine. This riveter is equipped with a swivel head for transferring the rivets from the lower end of a magazine into line with the ram of the machine after a hole has been punched through the two or more sheets of metal to receive the rivet.

The operator first depresses one of the foot-pedals, causing the ram to lower a hollow mandrel

Fig. 7. (Top) Traveling Drill Head and Carriage Provided on a Gantry Structure

Fig. 8. (Center) Air-operated Automatic Punching and Riveting Machine

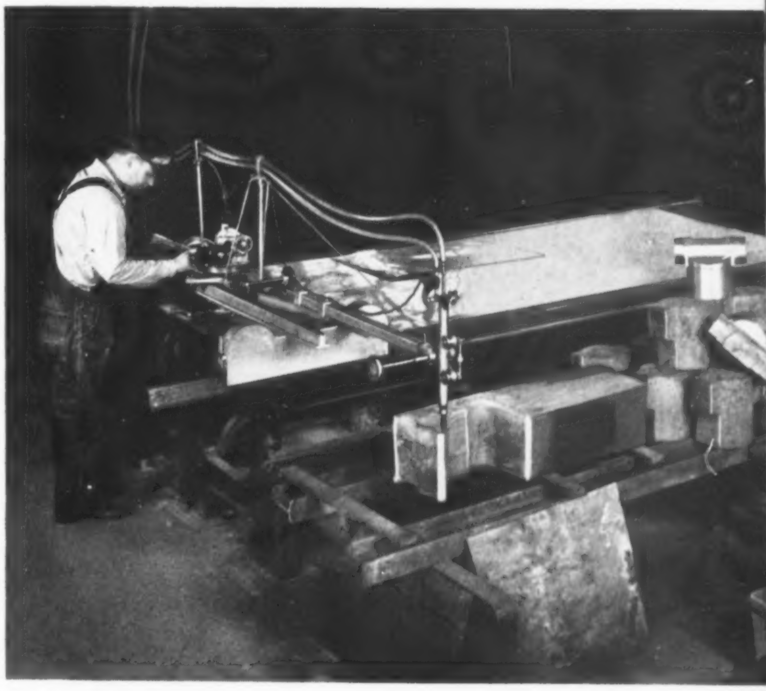
Fig. 9. (Bottom) "Sewing" Sheets of Aluminum Alloy on an Electric Spot-welder

on the work and to operate a punch upward from the pedestal on which the work rests. The punch remains in the punched holes to hold them in accurate relation with each other while the operator depresses the second pedal, causing the swivel head to swing into its second position and locate a rivet above the punched holes. The ram of the machine then comes down, pushes the rivet through the holes in the sheets being assembled, and the punch out of the holes ahead of it, the pressure of the punch causing the rivet head to be formed on the under side of the work. In Fig. 8 this machine is being used in assembling a gasoline tank baffle.

Sheets of aluminum alloy are "sewed" together to obtain lengths required for covering wing surfaces by the Federal spot-welding machine shown in Fig. 9. The sheets to be joined are laid on a spacing table which is advanced in short increments sidewise past the electrodes through a trip mechanism operated by the man at the left, so as to obtain a continuous weld. As the sheets are joined, they are rolled on the drum at the left-hand end of the spacing table. This table can be manipulated for welding from either side of the sheets.

When these skin sheets have been welded into the required lengths, they are so long that only a comparatively short section can be anodized at a time in an 8-foot deep tank. The anodizing operation is illustrated in Fig. 12. The cycle for anodizing each sheet section is thirty minutes. Anodizing is performed to obtain a good painting surface.

The Oxweld pantograph oxy-acetylene cutting machine shown in Fig. 11 is employed for cutting various parts to approximate shape that must be produced from forged steel. The illustration shows pieces of stock being cut out that will be machined as shown by the finished examples lying on the rough pieces at the right. In Fig. 10 is shown a close-up view of the pantograph head which controls the path of the cutting torch, this head being operated in a corresponding path over a templet constructed from narrow aluminum strips riveted to a thin steel plate.



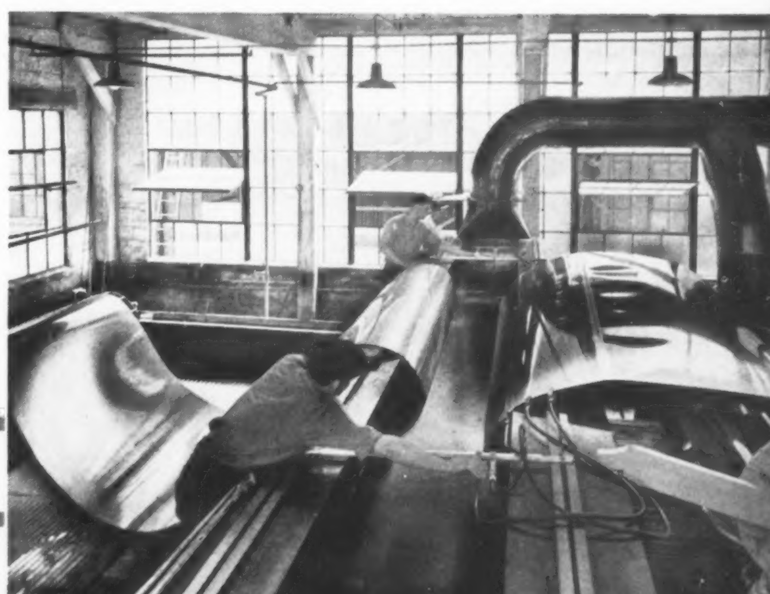
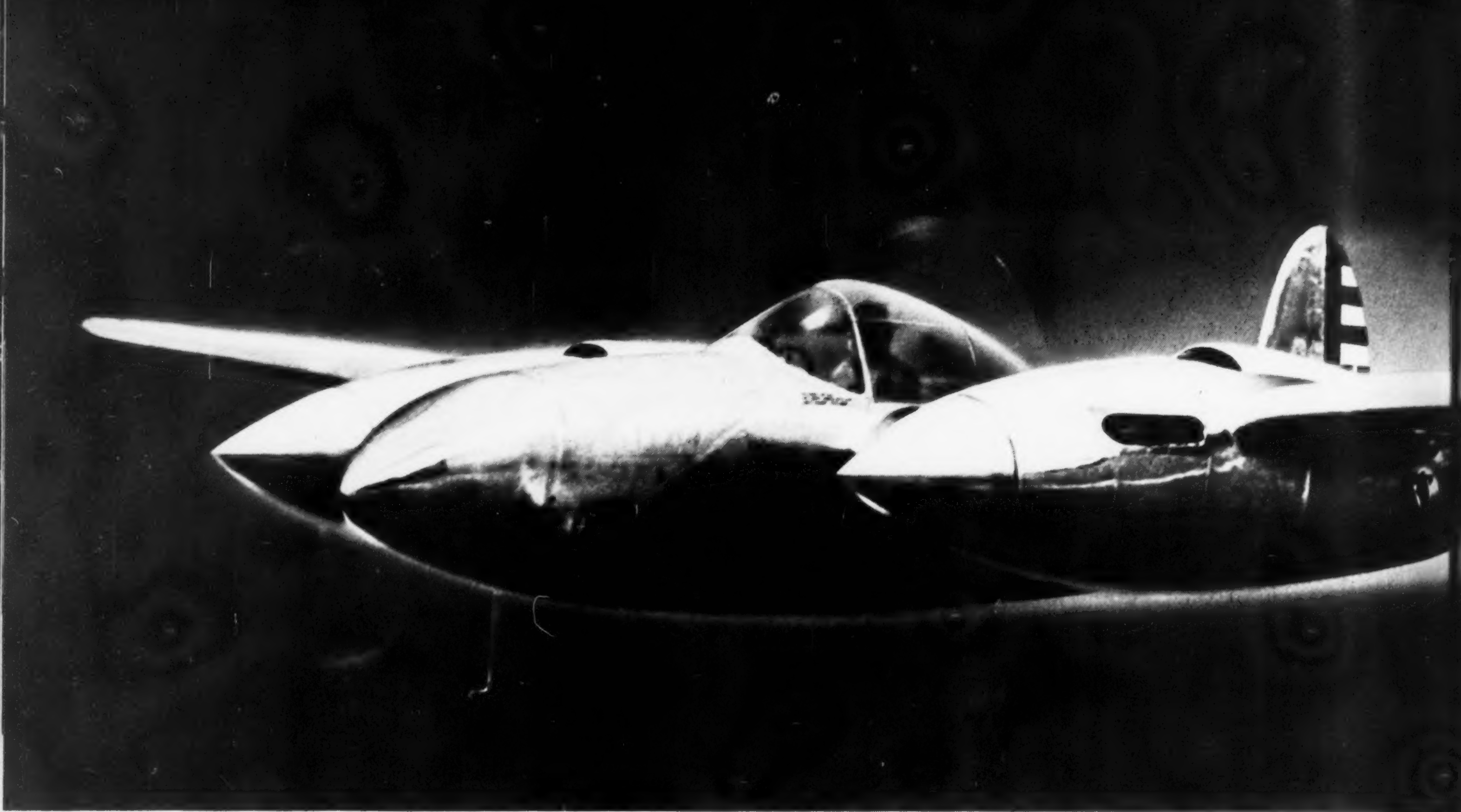


Fig. 10. (Top) Close-up View of the Pantograph Head of the Machine Shown in Fig. 11

Fig. 11. (Center) Cutting Rough Blanks of Airplane Parts on an Oxy-acetylene Machine

Fig. 12. (Bottom) Anodizing Tank for Treating Long Sheets of Aluminum



Allison Engines Built in a Shop as

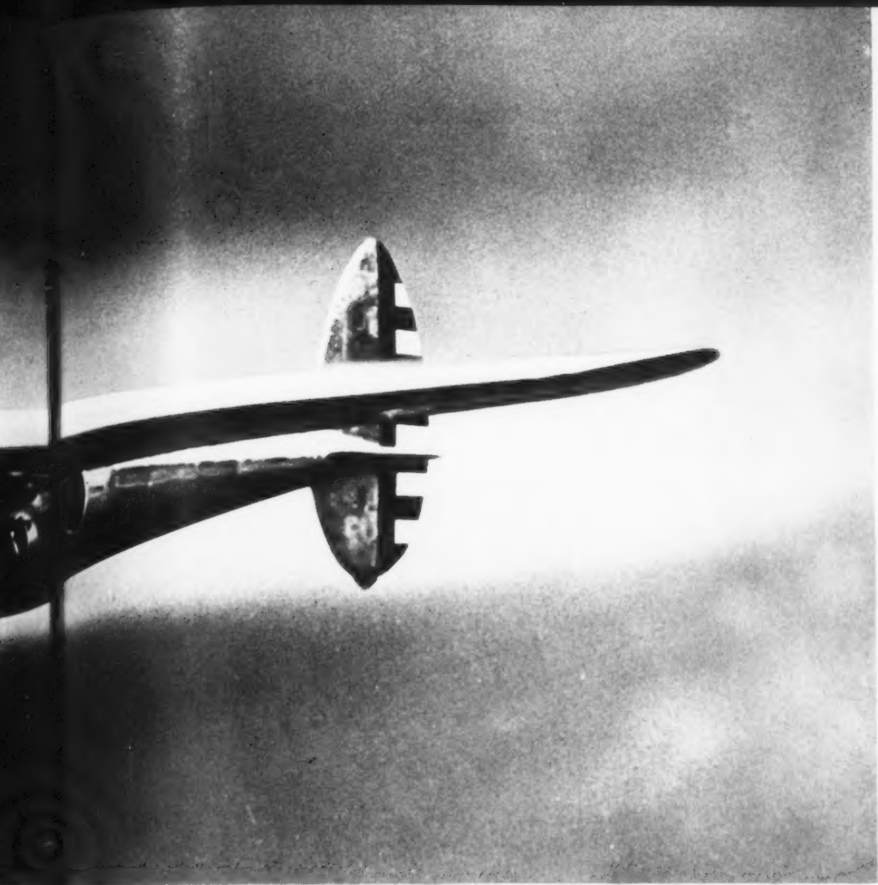
MOST revolutionary is the factory recently built at Speedway, Ind., by the Allison Engineering Co., Division of the General Motors Corporation, to produce liquid-cooled aircraft engines for planes of the United States Army. The new building is constructed entirely without windows, and is lighted artificially throughout, except in the offices that face the street, where natural daylight comes through glass-block panels that were built into the front of the structure purely for architectural effect.

The artificial lighting system is a late Westinghouse development that bathes the complete shop with a glareless white light such as is found on the north side of ordinary buildings on a clear summer day. Employes have the feeling that they are working in natural daylight rather than under an artificial lighting system.

Another outstanding feature is that the complete plant is air-conditioned to provide comfortable and healthful working conditions, and, what is perhaps more important, to insure that tools, work, and gages do not expand or contract any appreciable amount due to changes in temperature or humidity. Owing to the close control of humidity, the workmen will not perspire, and therefore, highly polished surfaces of work will not rust as a result of being handled by sweaty hands. Filters keep down the dust count in the atmosphere to a prescribed minimum, and there is a vacuum system that sucks away all abrasive particles coming from grinding operations. These provisions prevent dirt from alighting on work or being breathed into the lungs of the employes.

Modern as this shop is with regard to the building itself, it is fully as up to date with respect to the machine tool equipment. All the machines are brand new; some of the most interesting will be described.

A large Barnes "Hydram" drilling machine designed to operate in a manner that is exactly the reverse of conventional practice, in that the work is above the drill and revolves while the drill remains stationary, is shown at the right in the heading illustration. This machine is employed for drilling a hole 4 1/4 inches in diameter through solid bars of steel 16 1/2 inches long, which are to be made into propeller shafts. The upper end of the work is held in a chuck and the lower end in a special steadyrest, adjustable vertically along



Modern as Flight Itself

By CHARLES O. HERB

guide bars. The work-head is rapidly traversed by hydraulic power to the drill and then fed hydraulically at a slower speed for the drilling, which requires twenty minutes.

With this drilling method, no difficulty is experienced from chips clogging the drill, because they tend to fall away from the drill point. In addition, coolant at a pressure of 300 pounds per square inch is fed to the drill point through tubes embedded in the drill lands, which insures the discharge of all chips. Accurate centering of the hole throughout the full length of the propeller shaft is also facilitated by this unusual method of drilling. Previous to the application of this method, the practice was to first drill a small hole through the shaft and then enlarge it to the required diameter in a succession of drilling operations.

After this drilling operation, the propeller shaft is turned, faced, and bored in the Warner & Swasey turret lathe illustrated in Fig. 1. With one end of the propeller shaft held in the chuck jaws and the outer end supported by a revolving center on the hexagon turret, the part is turned and faced by tools on the square turret. The face of the flange is machined to a saucer shape. At the end of these turning and facing cuts, a special roller type steadyrest, mounted on the back of the bed, is employed to support the flange end of the propeller shaft during a series of four boring steps performed by tools on the hexagon turret.

One of the hexagon turret tools is used to machine a fillet on the saucer surface of the flange and to chamfer the flange. Then the four boring cuts are taken by tools mounted on bars approximately 4 1/2 feet long, pilots on the front end of the bars entering a bushing in the headstock to insure accuracy.

The bore in the propeller shafts is finally finished in the Heald internal grinding machine shown in Fig. 2. In this operation, the front end of the propeller shaft is supported in a special steadyrest mounted on the extended base of the work-head, while the rear end is held in an adapter in the work-head. At the end of this operation, the bore must be to size within plus or minus 0.001 inch, and straight within 0.0005 inch.

A unique Natco machine, used for spot-facing thirty-two bolt lugs at one time on rocker-arm covers, is shown in Fig. 3. The same machine is also employed for spot-facing corresponding lugs on

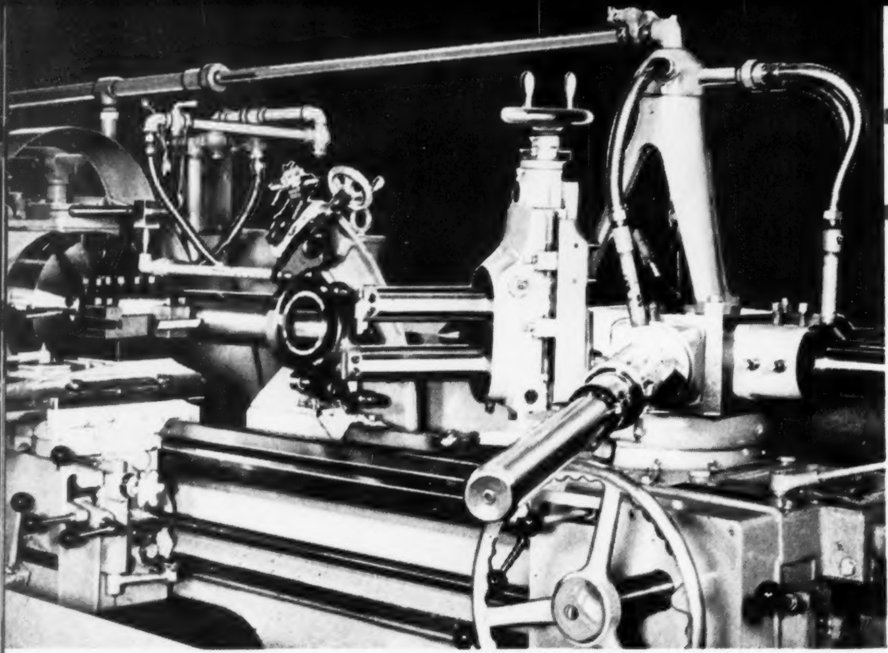


Fig. 1. (Above) Turning, Facing, and Boring Propeller Shafts on a Turret Lathe. Fig. 2. (Below) Grinding the Bore of Propeller Shafts

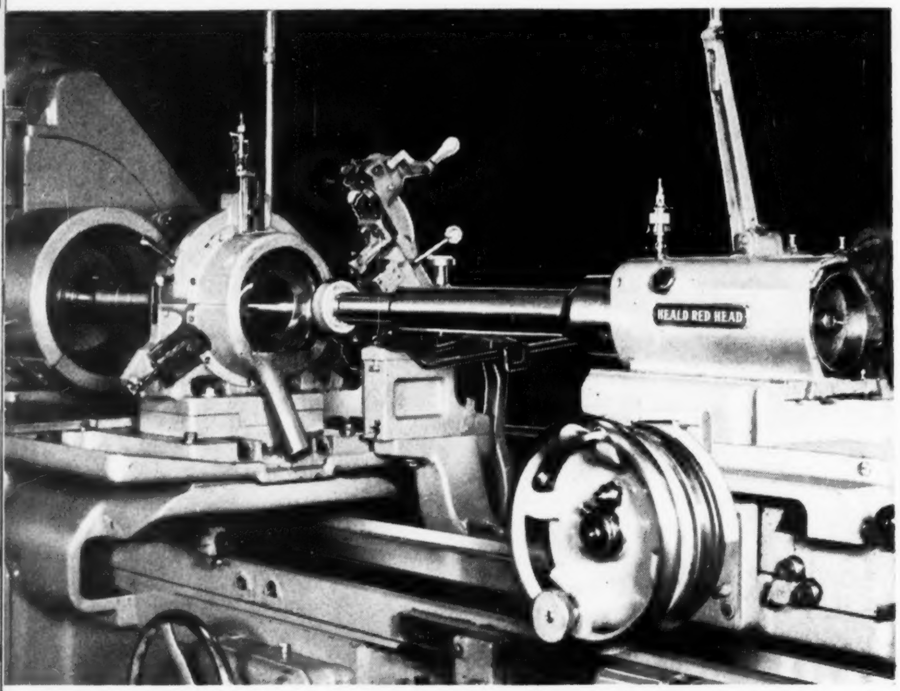
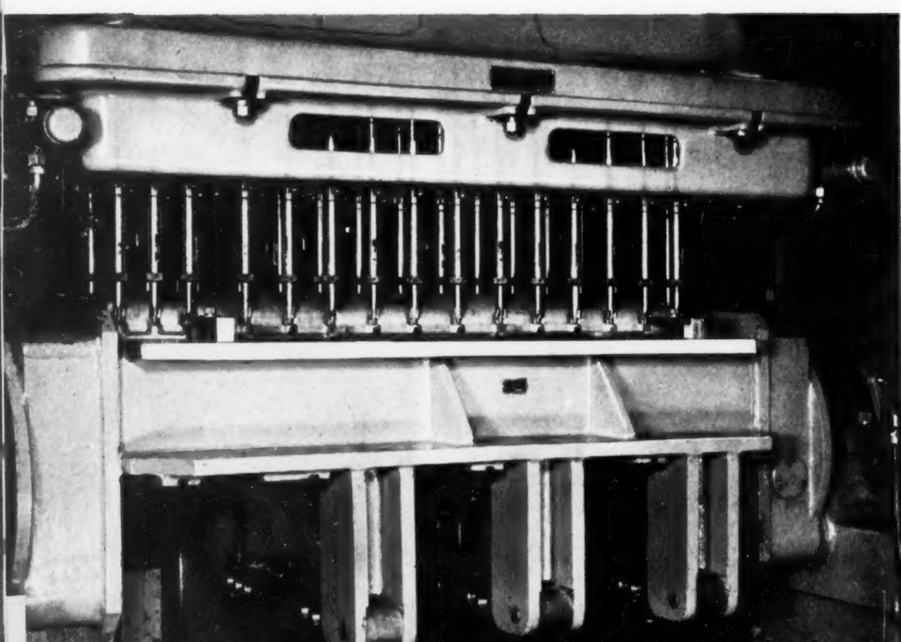


Fig. 3. (Below) Spot-facing and Drilling Rocker-arm Covers and Cylinder Heads through the Use of an Indexing Fixture



cylinder heads, in which case the workpiece is mounted on the other side of the fixture. The fixture is indexed through 180 degrees to bring this side of the fixture uppermost when cylinder heads are being handled. Indexing is accomplished by turning a large handwheel, there being a locking arrangement to hold the fixture in the indexed positions.

The same machine is also used for drilling holes through the bolt lugs of both cylinder heads and rocker-arm covers, in which case the fixture is indexed so as to place the casting on the under side. The drills can then be guided through bushings in the fixture. However, the castings are always loaded with the side of the fixture to which they are to be fastened uppermost.

Special nuts are "hexed" and castellated on the Milwaukee milling machine illustrated in Fig. 4, which is equipped with a double indexing fixture that enables the operation to be performed on six nuts while a similar number are being loaded. This operation is performed after the nuts have been produced from bar stock in automatic screw machines and tapped. The nuts are held by being screwed on studs on the fixture.

There are nine cutters on the arbor of the machine. The fixture is fed past the cutters three times for milling the hexagonal sides with the wide-faced cutters, the fixture being indexed between each pass. Then it is shifted horizontally to bring the center of each nut into line with one of the thin cutters, after which the nuts are again fed past the cutters three times, and indexed between each pass, for cutting the castellated slots.

Cylinder liners are ground after they have been assembled in the cylinder blocks by employing a special Heald internal grinder, as illustrated in Fig. 5. The block is clamped in a fixture on the machine table, and the table is indexed crosswise of the machine to bring the successive cylinder liners into alignment with the grinding wheel spindle. Liners have been ground in this operation to a smoothness of 7 to 9 micro-inches.

The diameters and faces of the bearings in the crankcase are finished on the Cincinnati Hydro-Matic milling machine shown in Fig. 6, which is equipped with an unusual work-holding fixture that encloses the cutters completely at the back. The work is clamped to hardened and ground vertical strips that extend across the front of the fixture, which is mounted on the regular table of the machine. The table is operated toward the left to carry the crankcase the required distance toward the cutters. The large cutter seen at the front end of the arbor machines one end of the crankcase, and there are twenty-four additional cutters which straddle-mill the ends of the bearings and machine the half-bores. Positive stops guard against feeding the fixture into the cutters. The machine table is actuated hydraulically.

Upper crankcase castings are finish-milled by the the Cincinnati Hydro-Tel milling machine shown in Fig. 7. The crankcase is supported on the inclined surface of a special fixture, and is indexed from one angle to another. The cutter can be manipulated back and forth, crosswise of the table, and up and down, as required.

Finish-cutting of the teeth on a ring gear having forty-four teeth of 3 1/2 diametral pitch is illustrated in Fig. 8. This operation, as well as that of gashing the teeth, is performed on a Fellows gear shaper equipped with a fixture designed to insure accurate loading of the work and retaining of the cutting oil.

The teeth of the gears are later rounded both along the front and the rear of the profiles by the Cimatool machine shown in Fig. 9. In this illustration, the tool is shown being applied to the rear ends of the teeth. In rounding the teeth at either the front or back, the tool remains in one position while the gear revolves and, at the same time, moves back and forth, as well as sidewise, to keep the changing contour of the teeth against the cutter. The movements of the work-head are derived from cams. The ground bore of the gear is gripped securely on a hardened and ground ring by a three-arm clamp operated by hydraulic pressure.

The ring gears are finally lapped on the Fellows LS type machine illustrated in Fig. 10. In this operation, the gear is located from the ground periphery, and is run a predetermined length of time in both directions. A kerosene-carborundum lapping compound is used.

A Hanchett surface grinder is used for finishing the joint face of exhaust pipe flanges as shown in

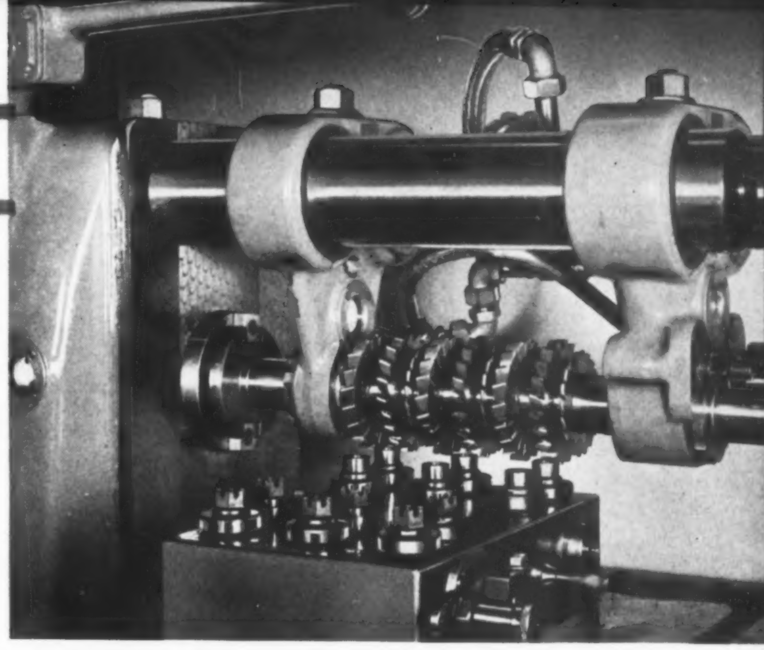


Fig. 4. (Above) Milling Hexagonal Sides of Nuts and Cutting Castellated Slots. Fig. 5. (Below) Grinding Cylinder Sleeves after Assembling

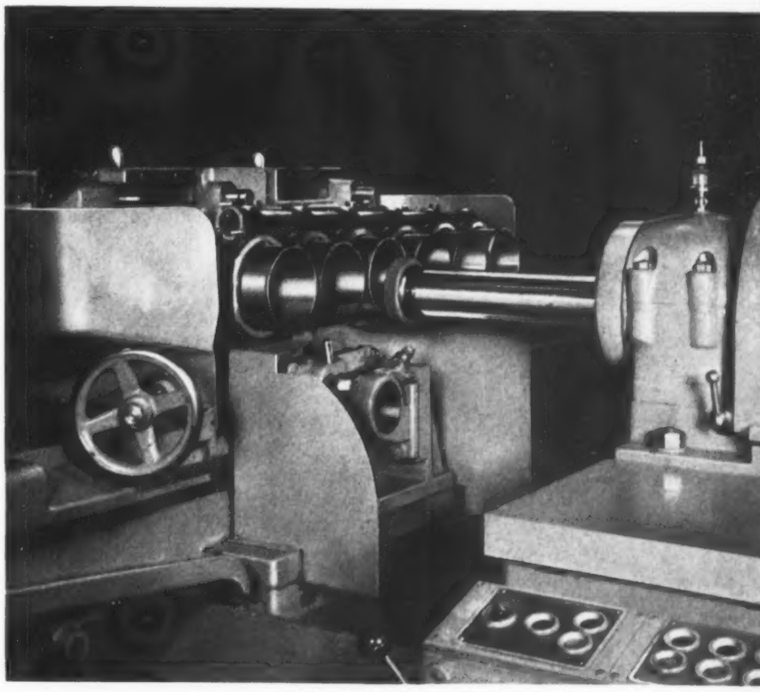
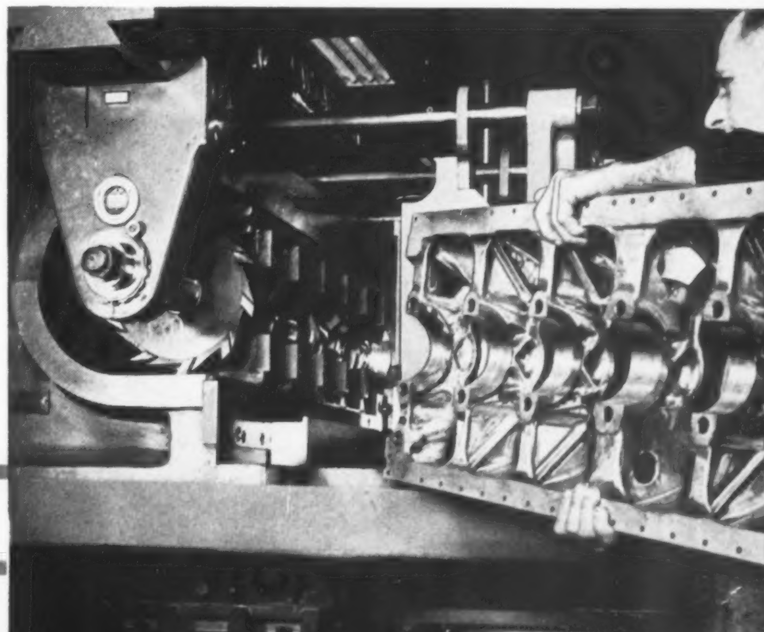


Fig. 6. (Below) Milling Machine Employed for the Simultaneous Finishing of the Bearing Diameters and Faces of Crankcases



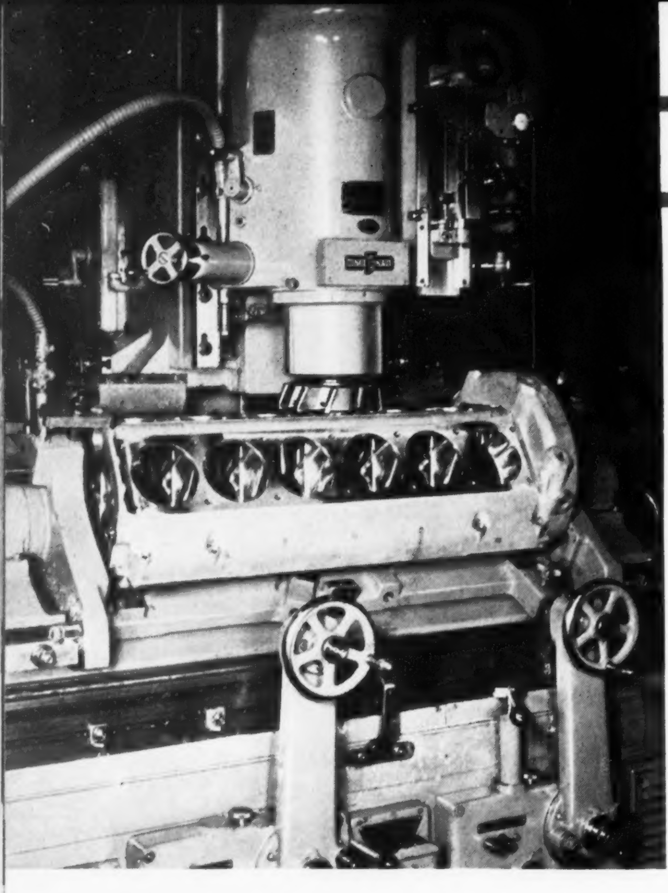


Fig. 7. (Top Left) Machine Employed for Finish-milling Cylinder Deck of the Upper Crankcase Castings

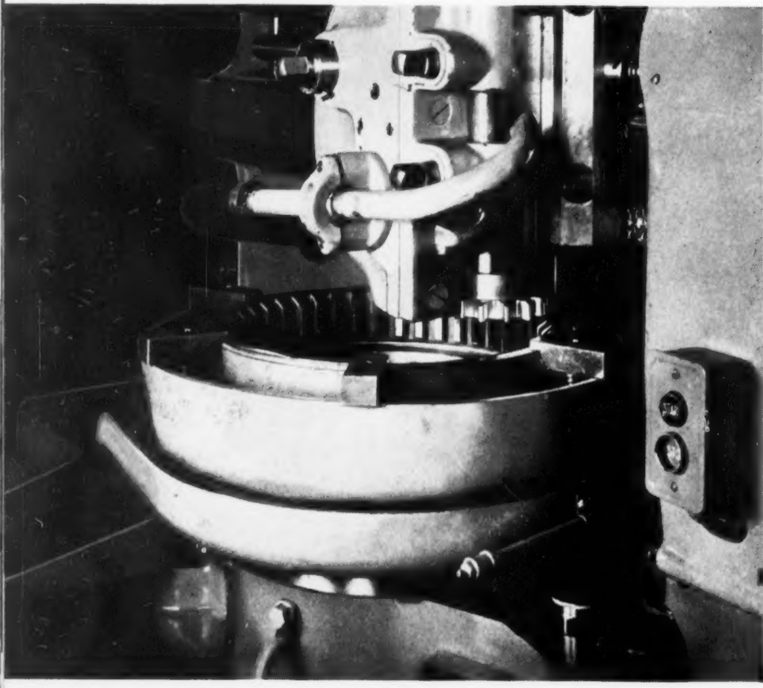


Fig. 8. (Center) Finish-cutting the Teeth of a Ring Gear on a Gear Shaper which is also Employed for Rough-gashing the Teeth

Fig. 11. Nine pieces are ground in one operation by mounting three parts on each of the table fixtures. The parts are held on the fixtures by manually operated equalizing clamps.

Fig. 12 shows a Model K vertical type Milwaukee milling machine employed for cutting relief on the inner wall of the skirt on both sides of pistons to reduce the weight. After a piston has been loaded, the operator feeds the cutter to the required depth and then the work is fed sidewise and swiveled for cutting the relief groove the required distance around one side. The cutter is now withdrawn and the cycle repeated for milling the relief on the opposite side. A tulip-shaped milling cutter is employed for this operation.

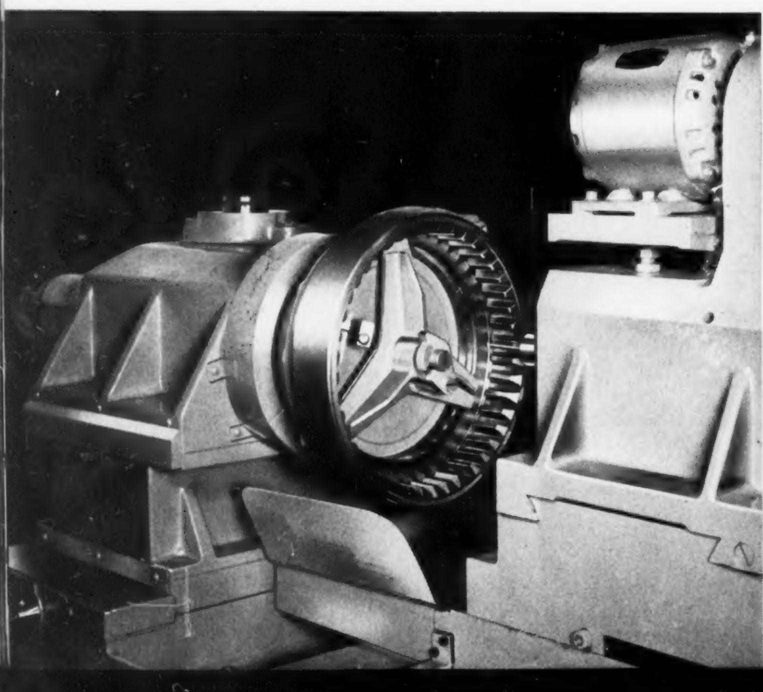


Fig. 9. (Below Left) Machine Employed for Rounding the Teeth of Ring Gears both Along the Front and Rear Edges

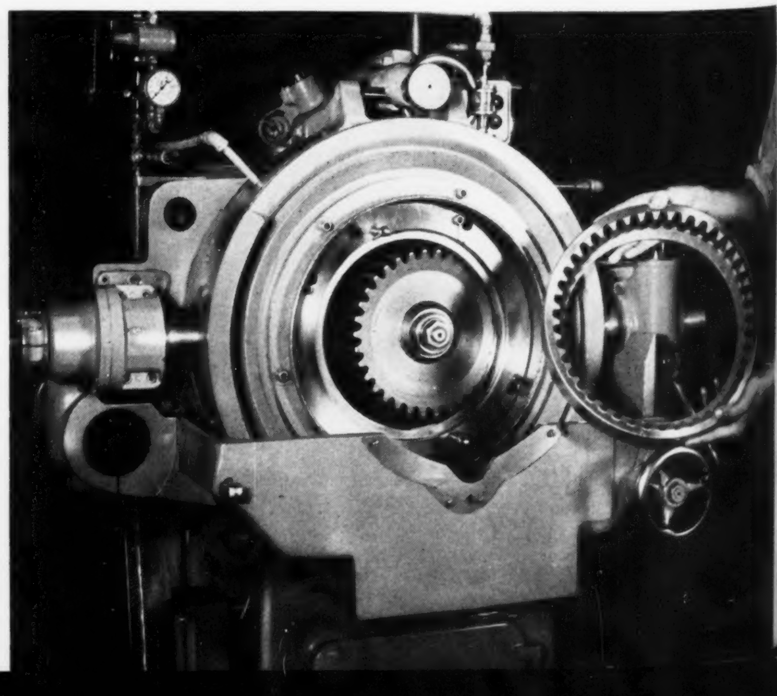


Fig. 10. (Below Right) Ring Gears are Finally Lapped to Obtain the Desired Accuracy and Finish on the Gear Teeth

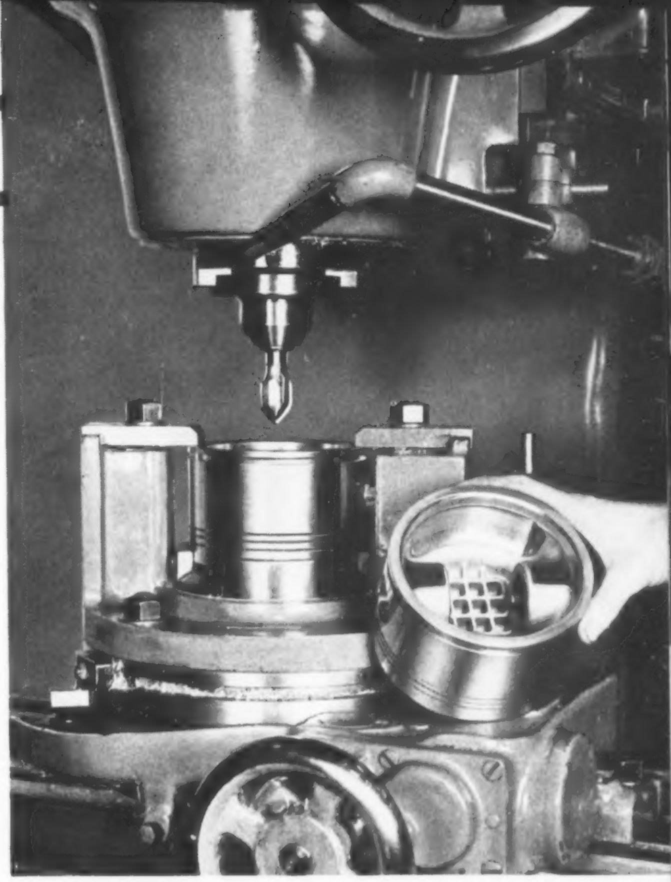


Fig. 11. (Below Left) Finishing the Joint Faces of Exhaust Pipe Flanges in a Production Operation Performed on a Surface Grinder

Fig. 12. (Top Right) Milling Machine Equipment Employed in Cutting Relief around Both Sides of Pistons from the Inner Wall

A Warner & Swasey turret lathe employed for boring and counterboring supercharger drive housings is illustrated in Fig. 13. Tools on the hexagon turret are used for boring, and four tools on the square turret for facing and counterboring. The 10-inch diameter face of the work must be finished parallel with the opposite side and flat within 0.001 inch, and this surface must have a smoothness within 10 micro-inches. The supercharger drive housings are made of aluminum.

A typical operation on a Giddings & Lewis horizontal boring, drilling, and milling machine is illustrated in Fig. 14. This consists of rough-boring a bearing for the reduction gear in a lower crankcase casting. A fly cutter is being used.

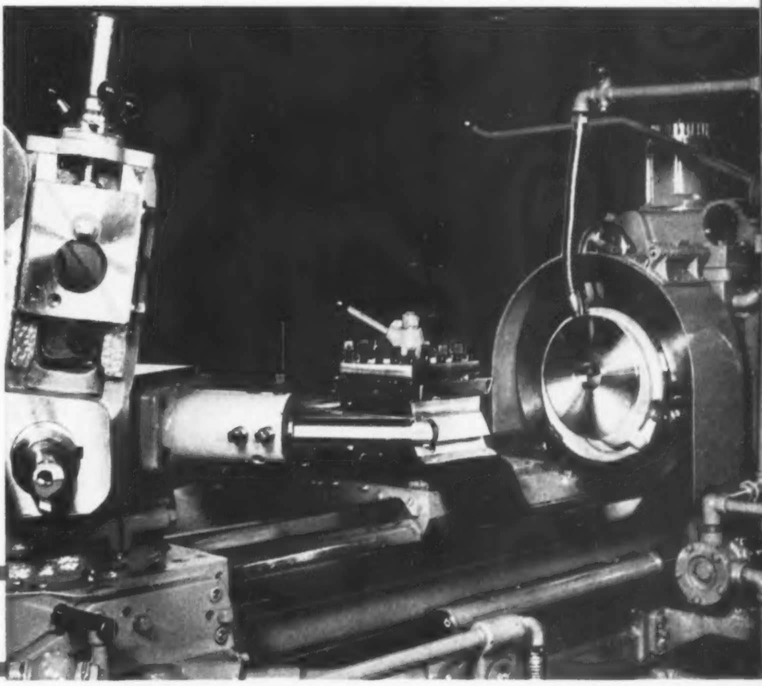
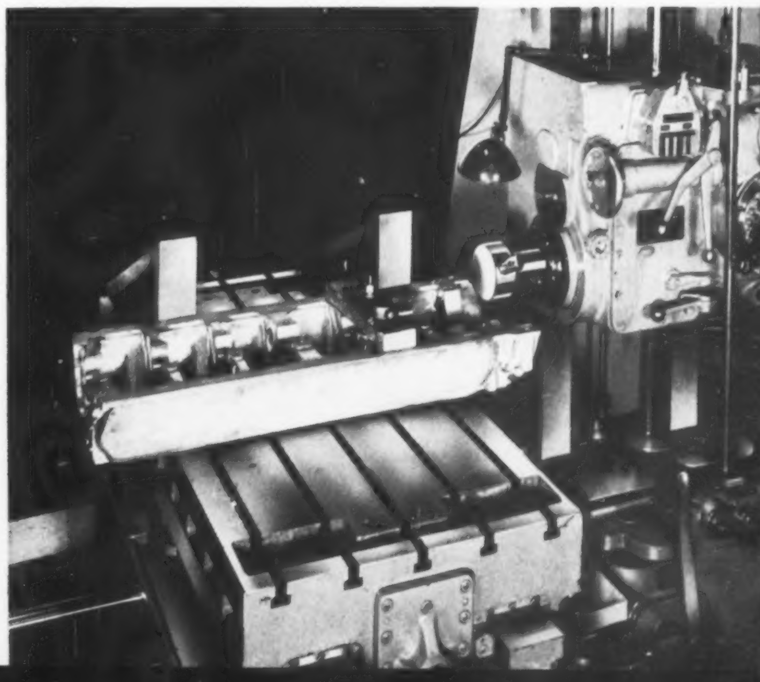
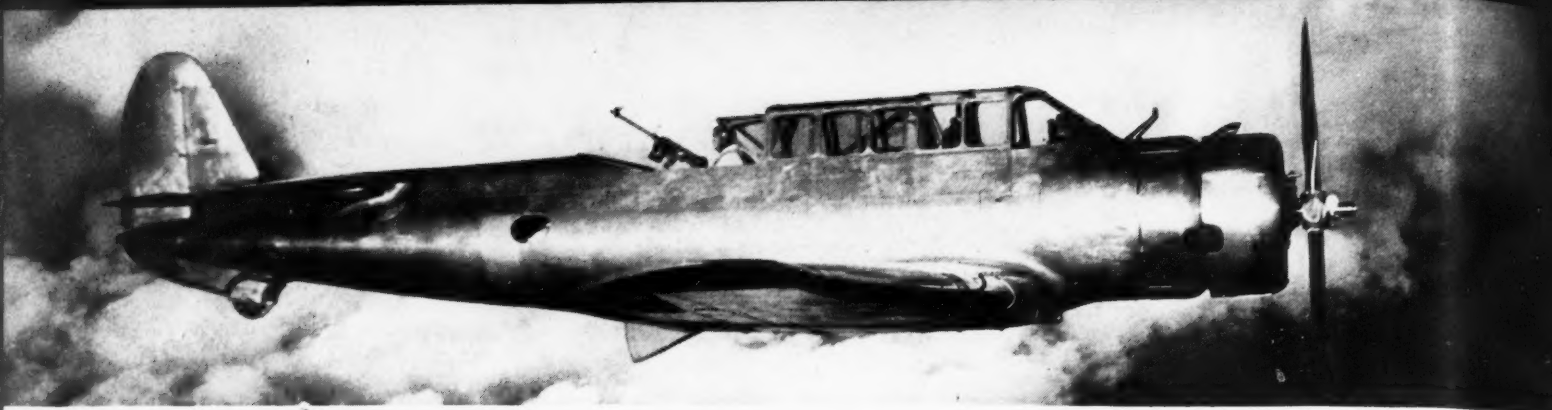


Fig. 13. (Center) Turret Lathe Operation in which a 10-inch Diameter Surface Must be Machined Parallel within Close Limits

Fig. 14. (Below Right) Rough-boring a Reduction Gear Bearing of a Lower Crankcase in a Typical Boring Mill Set-up





Vultee Methods Speed Production

IN line with the expansion program of the aircraft industry, Vultee Aircraft, Inc., Downey, Calif., has doubled its size in the last six months. This afforded the opportunity of aligning the entire plant with a newly developed production system which gives it the distinction of being one of aviation's most efficient factories. This production system was developed on a straight-line basis by engineers and production men of wide experience in airplane manufacture with the object of reducing to a minimum the handling of raw materials, parts in process of manufacture, and assemblies.

Before this new plant was laid out, an investigation of the industry showed that as much as 70 per cent of the time involved in building airplanes was spent in moving parts and assemblies between machines and departments. With the methods adopted at the Vultee plant, loss of time in handling work is comparatively negligible. Raw materials are fed from storage rooms at one end of the factory to the adjacent machine shop and sheet-metal department. Parts in process advance through these departments, without any back-tracking, direct to sub-assembly departments, the paint room, heat-treating department, etc., then to the wing, center section, and fuselage assembly departments, and the final assembly lines. Original production plans can be easily extended to permit further increases in shop space to be made without any decrease of efficiency.

Production has been speeded up, not only by this reduction in work handling, but also by increasing the speed of manufacturing operations. Revolving jigs have greatly expedited welding; a rotary platen enables a hydraulic forming press to be kept in continuous operation; and cutter-spindle speeds of over 10,000 R.P.M. permit aluminum parts to be machined in one-fifteenth the time formerly required. Also several automatic riveters are employed which punch the holes in metal sheets, insert the rivets, and drive them automatically in "sewing machine" fashion.

The Vultee plant is devoted at present to the production of fighting and training airplanes, of which the outstanding development is the "Vanguard," a pursuit plane that is one of the world's fastest and most maneuverable planes of this type. It is driven by a 1200-H.P. Pratt & Whitney engine, and normally carries six machine guns, although it can be equipped with as many as ten. This plane can also be equipped with two cannon

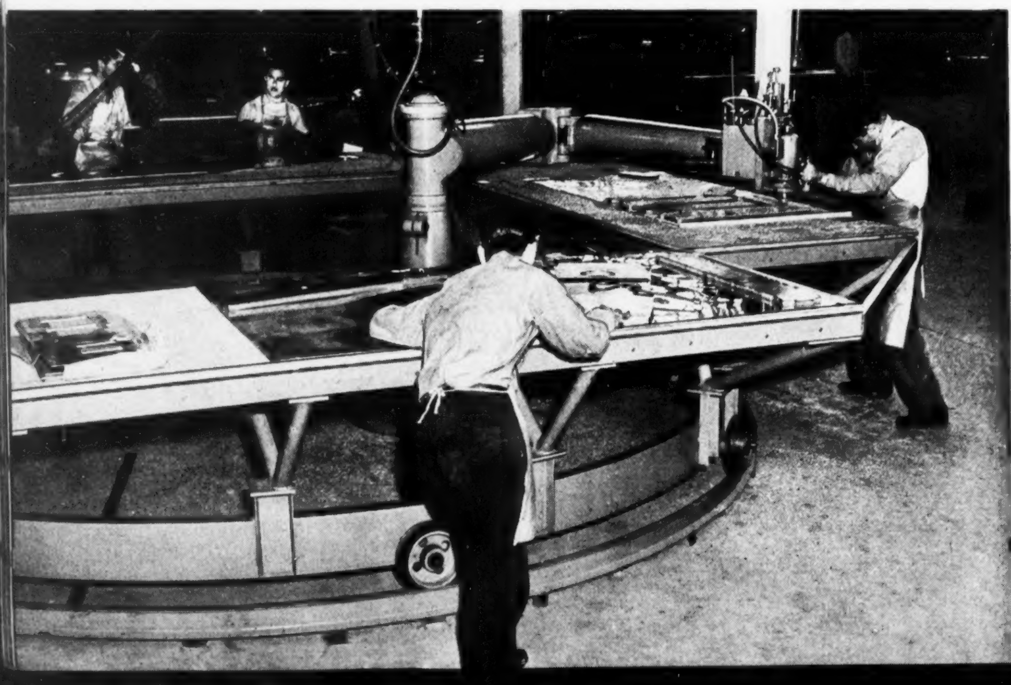


Fig. 1. A Large Rotary Table with Four Loading Sections has Greatly Speeded up the Routing of Sheet-metal Blanks for the Forming Press and Drop-hammers

# of Fighting Planes

By HAROLD M. HARRISON
Factory Superintendent, Vultee Aircraft, Inc.

of 20-millimeter caliber. Among other planes the plant is prepared to produce in quantities are the "Valiant" basic combat and advanced trainer, the "Valiant" basic trainer, and the Vultee V-12 attack-bomber which carries up to 3000 pounds of bombs. Some of the outstanding operations in building these planes are described in this article.

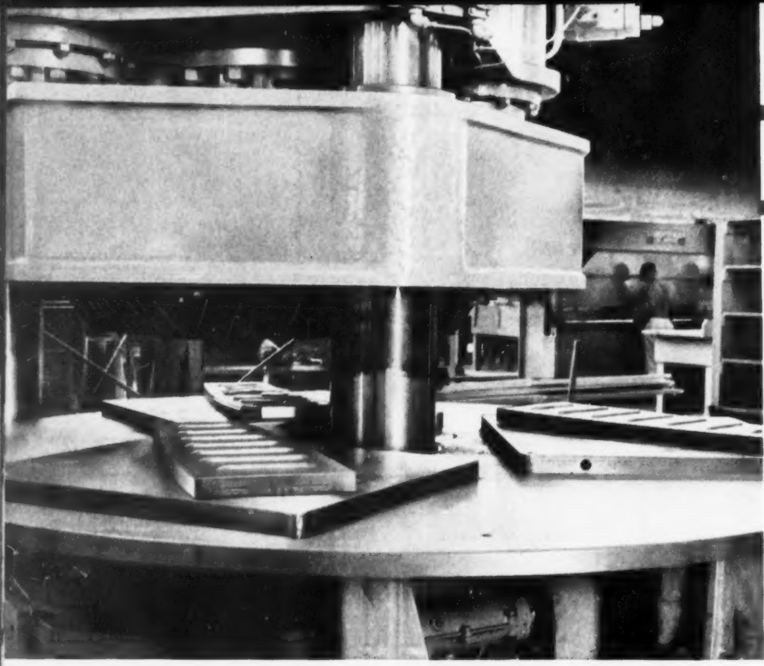
Following conventional practice in the airplane-building industry, blanks for parts to be formed from sheet-aluminum alloy are cut by radial routing machines in accordance with templets fastened on top of stacks comprising ten to twelve sheets. Routing has been greatly speeded up in the Vultee plant by the provision of the large rotary table seen in Fig. 1, which runs around a routing machine provided with an arm 9 feet long. Four table sections with plywood tops 10 feet long by 4 feet wide provide a means of keeping the routing machine in constant operation, because finished work can be removed from these tables and new stacks of sheets and templets loaded quickly enough so that another stack of sheets can be pushed beneath the routing head as soon as the cutting of one stack has been completed.

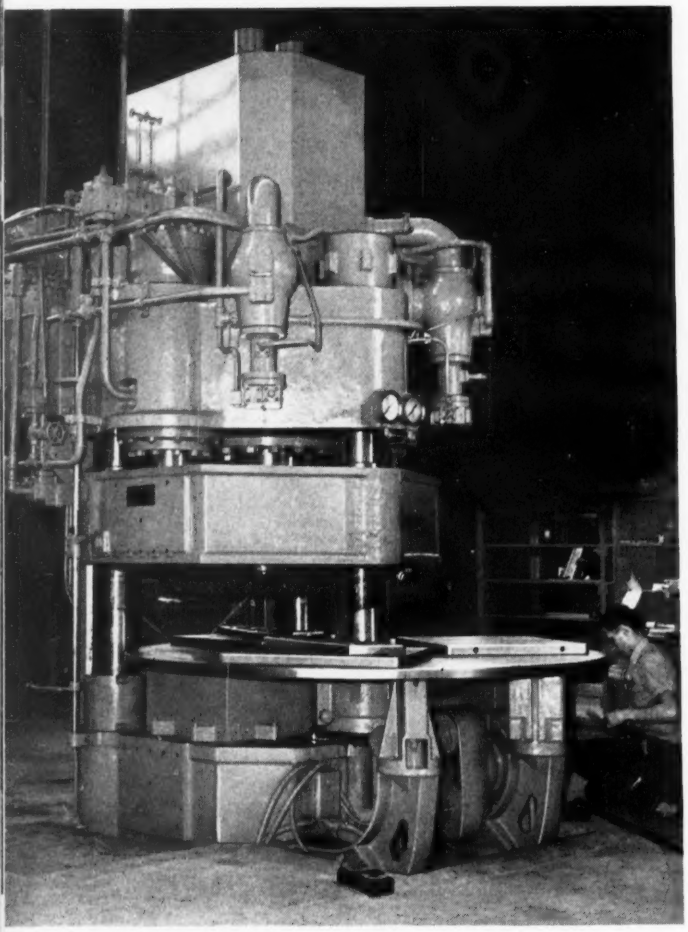
The channel track on which the table wheels run is 16 feet in diameter, and the wheels or casters are 7 inches in diameter. The table frame is largely built up of welded construction and assembled by bolts. The Shrillo routing head runs at a speed of 12,000 R.P.M.

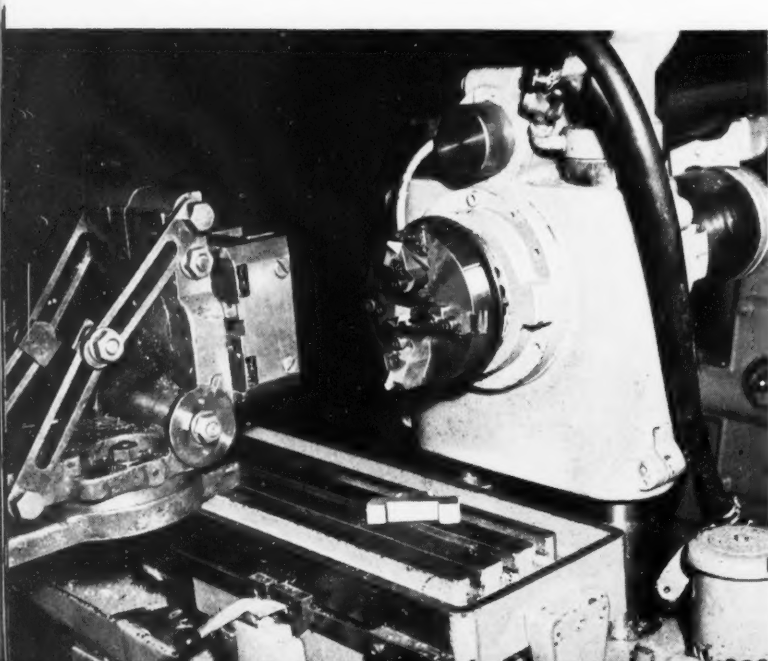
Within 15 feet of the routers is the Williams-White three-column hydraulic press illustrated in Fig. 4, to which the routed sheets go for forming and piercing operations performed over Masonite and steel forms, as in conventional practice. The operation differs from customary procedure, however, in that a circular work-platen is revolved by power around the front column of the press to carry the blanks of work and their dies beneath the ram and to bring the finished pieces with their forms in front of the ram. While each operation is in progress, new work is being loaded on the portion of the platen that is outside of the press ram.

This machine works entirely automatically and keeps two operators busy reloading. As the press ram rises after each operation, the rotary table automatically swings new work into position. With this arrangement, no time is lost in loading and unloading. The operation is also unusually fast, because the press ram moves at a speed of 640 inches a minute. Safety of the operator is another

Fig. 2. Milling Machine Provided with a Special High-cycle Electric Motor Drive that Gives Spindle Speeds up to 10,000 R.P.M. for the High-speed Milling of Aluminum Pieces







important factor, it never being necessary for the men to reach beneath the press ram. The close-up view in Fig. 3 shows three forms on the rotary platen. The press has a rating of 1200 tons.

An operation typical of the speed obtained in the machine shop is illustrated in Fig. 2, which shows a milling machine developed by Vultee, equipped with a high-cycle electric motor drive that gives spindle speeds up to 10,000 R.P.M. This machine applies the fast cutting methods of woodworking equipment to the machining of aluminum-alloy parts. Milling cutters with teeth having a sharp rake and a generous amount of clearance are used.

A close-up view of another operation on this high-cycle milling machine is shown in Fig. 5. In this case, a special head with four slots in which cutters can be adjusted radially is mounted on the machine spindle. The head is shown equipped with three fly cutters for finishing two flat legs on aluminum castings such as seen lying on the table, and for machining the clearance space between the legs. The work is mounted on the upright face of the fixture at the front of the table, and the operation is performed as the work is fed horizontally past the cutter-head. In this operation, the table is fed at the rate of 144 inches a minute, and the cutters are run at 7500 R.P.M.

The application of standard woodworking machinery to the machining of aluminum parts is illustrated in Fig. 6, which shows a Gallmeyer & Livingston wood shaper being used to finish aluminum castings according to the outline of fixtures in which they are held. A regular wood-shaper tool bit is mounted on the machine spindle, there being a collar below the tool that is guided along

Fig. 3. (Top) Close-up View of the Rotary Table on the Three-column Hydraulic Press Illustrated in Fig. 4

Fig. 4. (Center) Three-column Hydraulic Press which is Equipped with a Rotary Table that Permits Reloading of Work and Dies while the Press is in Operation

Fig. 5. (Bottom) Operation on a High-speed Milling Machine, in which Three Fly Cutters are Used for the Simultaneous Finishing of Three Surfaces

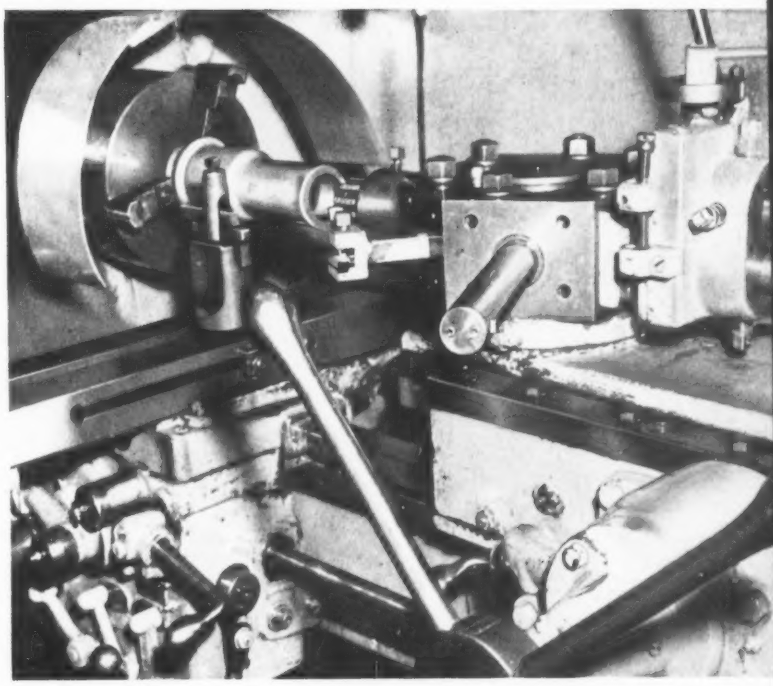
the contour of the combined fixture and templet, so as to produce the same contour on the work. The work is merely "wiped" across the cutter, the latter being run at 11,400 R.P.M.

The machine shop has a battery of turret lathes, Fig. 7 illustrating a typical operation performed on a Warner & Swasey machine. This operation consists of finishing an oleo cylinder for a tail wheel. The part is an aluminum-alloy casting, 9 3/4 inches long. The operation consists of boring a 5 1/4-inch long hole in one end to 2 inches in diameter within plus 0.0005 inch minus nothing, and counterboring and tapping the hole.

A tool on the first face of the turret rough-bores the hole; a tool on the second face finish-bores it; a tool on the third face counterbores it; a tool on the fourth face applies a Madison reamer; and, finally, a tap on the fifth face cuts the thread. This thread is held to the required pitch diameter within plus 0.0032 inch minus nothing. Tools on the cross-slide face the end of the work and cut a groove within the bore. A similar set-up is employed for machining the opposite and larger end of the cylinder.

One of the latest machines in the sheet-metal department is the "Sturdybender" press brake illustrated in Fig. 8. This is a small high-speed machine measuring 8 feet 6 inches between housings which is used for a variety of work, including the forming of sheet metal into curves by the use of rubber in combination with a steel punching member.

A second installment of this article, to be published in a coming number of MACHINERY, will describe additional operations in the Vultee plant, including milling, precision-boring, punching, and electric-arc and spot welding operations.



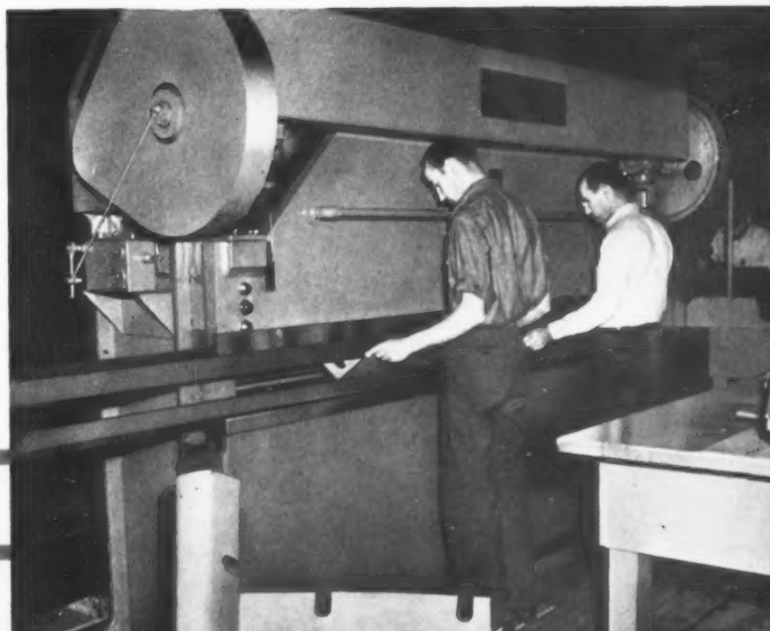


Fig. 6. (Top) Employing a Standard Wood Shaper for the Fast Finishing of Aluminum Pieces to Required Profiles

Fig. 7. (Center) Turret Lathe Set-up Employed in Boring, Counterboring, and Tapping Oleo Cylinders for Tail Wheels to a High Degree of Accuracy

Fig. 8. (Bottom) Typical Operation on a Small High-speed Press Brake Used for Forming Sheet-metal Pieces to Sharp Bends, as well as for a Variety of Other Work

Pratt & Whitney's Advanced Methods

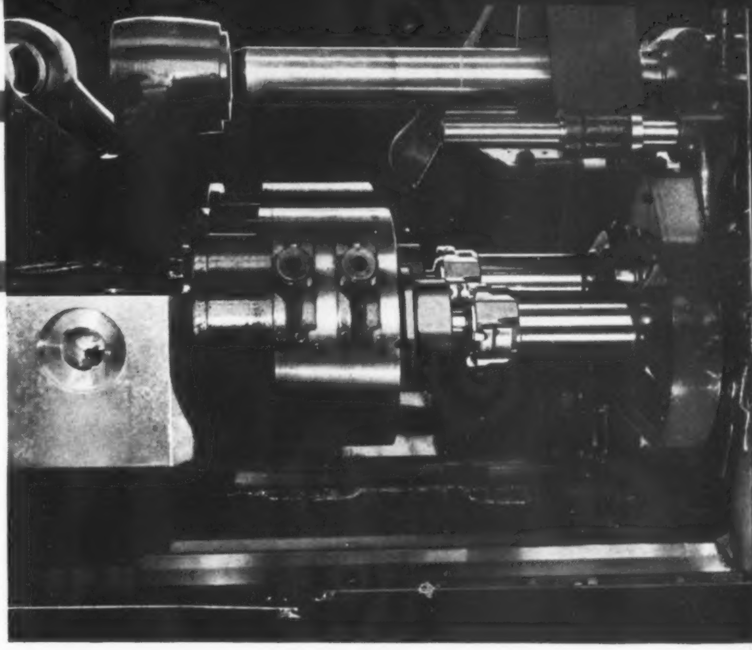
WHAT has been going on in the aircraft industry during recent months is strikingly indicated by the expansion in the production capacity of the Pratt & Whitney Aircraft Division of the United Aircraft Corporation, East Hartford, Conn., that has taken place in the past year. Although the capacity has been tripled during the last twelve months, plans have been made for immediate further expansion as a result of the new National Defense Program. The latest addition will increase the present production 50 per cent by the end of this year.

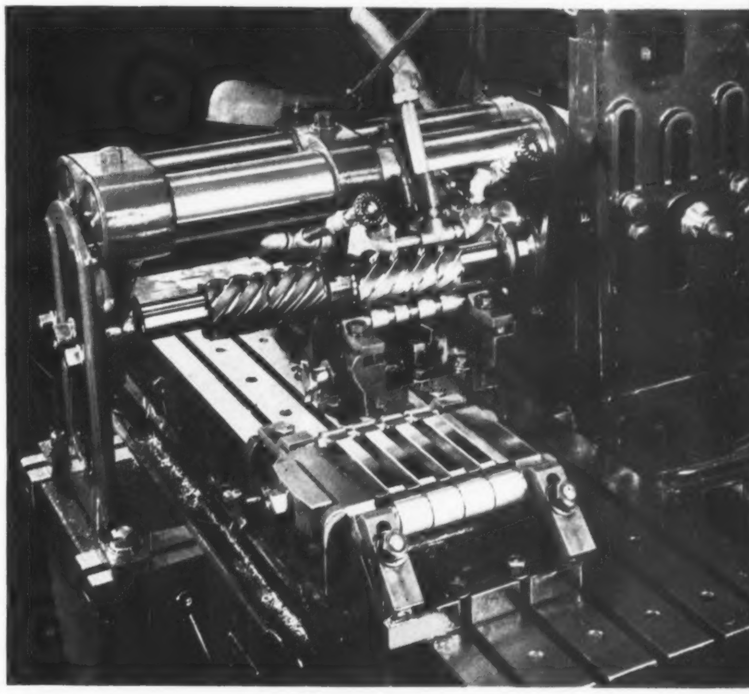
With the vast expansion of production facilities by the aircraft-building industry, there has been not merely the addition of standard types of machine tools similar to others that have been turning out aircraft parts heretofore. In many instances, the machines installed are of original designs; and in cases where standard machines are employed, they have invariably been provided with fixtures and tools designed to give the highest possible production rates.

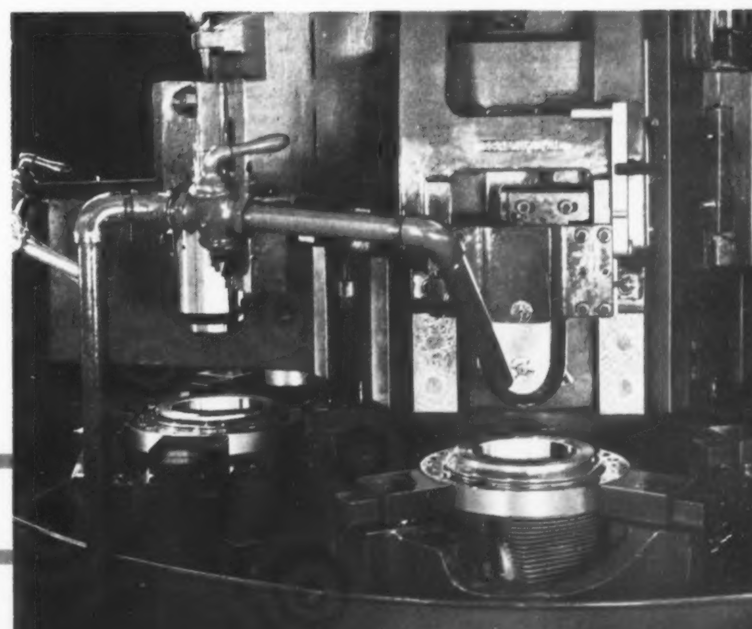
A few of the many machines installed during the last few months at the Pratt & Whitney radial aircraft engine factory are shown in the accompanying illustrations. For example, there are Potter & Johnston automatics for rough-boring cylinder barrels, which differ radically from the conventional design of such machines in that the workpieces are mounted on the turret and held stationary during the operation while cuts are taken by revolving boring-heads driven from the machine headstock.

The four-sided turret of this machine, which is illustrated in Fig. 1, is equipped with two chucks on two sides so that cylinder barrels can be loaded on one side while the cylinder barrels supported on the opposite side are being bored. Chucks could, of course, be furnished on all four sides of the turret if desired. The chuck jaws are tightened and

# of Engine Building







loosened by the application of a crank-handle. The rough 5 5/16-inch holes in the cylinder barrels are bored in this operation to a diameter of 5.475 inches, within plus or minus 0.005 inch, the barrels being 9 1/2 inches long. Accuracy is insured by two guide bars on the headstock that enter bushings provided at the top of the turret as the latter advances to feed the cylinder barrels past the cutters. There is also a long pilot-bar projecting forward from each chuck that enters a bushing in the headstock. Four cutters are provided on each tool-head.

The sides of four articulated rods are slab-milled simultaneously on a Milwaukee Simplex milling machine set up as shown in Fig. 2. The four rods are assembled on two arbors which pass through the bores at both ends. One of these arbors is ground square on the ends to provide flat surfaces for accurate locating and clamping purposes, while the other arbor is ground three-sided on the ends for the same purpose. Two fixtures and two sets of cutters enable a group of four articulated rods to be loaded while another group is being milled.

Bullard Mult-Au-Matics of six-spindle design are tooled up as shown in Figs. 3 and 4 for machining aluminum-alloy cylinder heads. The first operation on the cylinder heads, which is performed in the station seen at the right in Fig. 4, consists of rough-machining the straight length of the bore and of turning and facing the flange, all of these cuts being taken by tools fed straight downward. In the next working station of the machine, which is seen in the middle of the illustration, the dome is rough-machined on the inside to the desired radius by a tool that is fed along an arc after it has

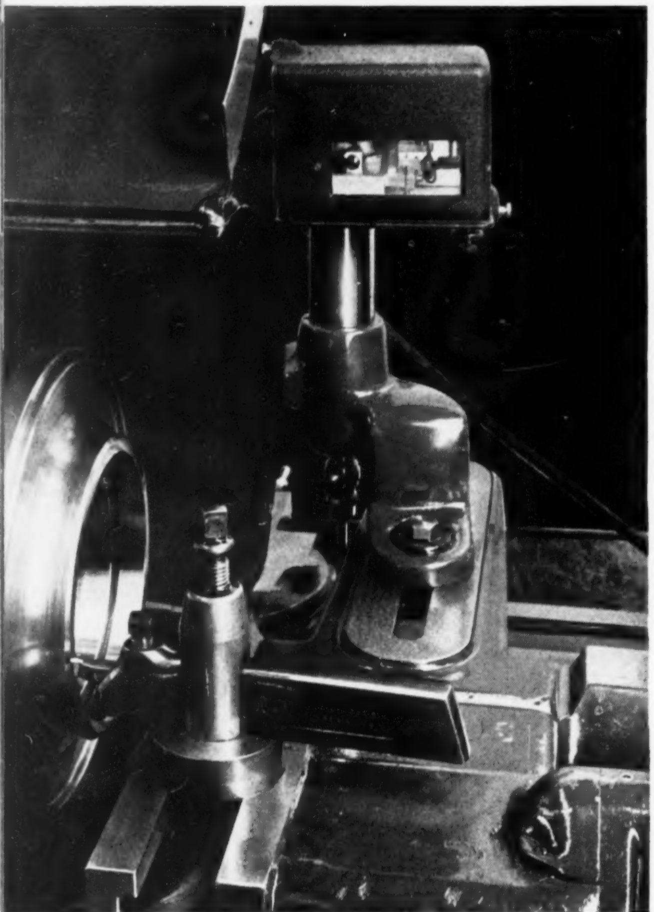
Fig. 1. (Top) Rough-boring Cylinder Barrels on an Automatic in which the Forgings are Held Stationary on the Turret while the Tools Revolve

Fig. 2. (Center) Milling Machine Set-up Employed in Finishing the Sides of Articulated Rods Four at a Time

Fig. 3. (Bottom) Fourth and Fifth Working Stations of the Mult-Au-Matic Illustrated in Fig. 4

Fig. 4. (Left) First, Second, and Third Stations of a Mult-Au-Matic Set-up for Machining Cylinder Heads

Fig. 5. (Center) Lathe Operation in which a Part is Automatically Machined to the Required Contour by a Tool Guided from a Templet



been lowered to the required height. In the third working station, which is seen at the left in Fig. 4, the flange is finish-faced and under-cut by tools that are fed sidewise after having been lowered to the required heights.

The inside of the dome is finished in the station seen at the right in Fig. 3 by a tool that is fed automatically along an arc similarly to the tool in the second working station. Finally, in the fifth working station, seen at the left in Fig. 3, tools are fed straight downward for finish-boring the thread and the "shrink" surfaces, for finish-turning the flange, and for rounding the outer flange corner. Bore diameters are held within plus or minus 0.002 inch in this operation. Varnolene is used as the cutting coolant.

In Fig. 5 is shown a Monarch engine lathe being used for turning an irregular contour on a part. The tool is automatically guided along the required path by a templet and roller at the back of the bed as the carriage is fed longitudinally.

The Cincinnati Bickford radial drilling machine shown in Fig. 6 is used for performing a series of drilling, boring, and reaming cuts on the rear accessory section. As many as ten tools are used on one casting, the tools being stored on the stands

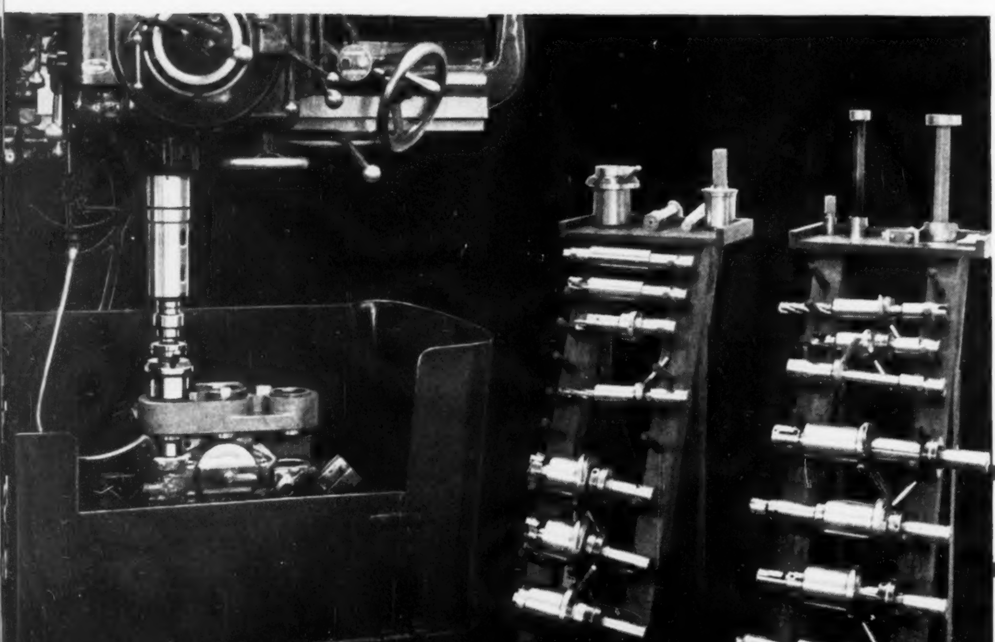


Fig. 6. Radial Drill and Tools which are Used Interchangeably for Taking a Large Number of Cuts on Rear Accessory Sections

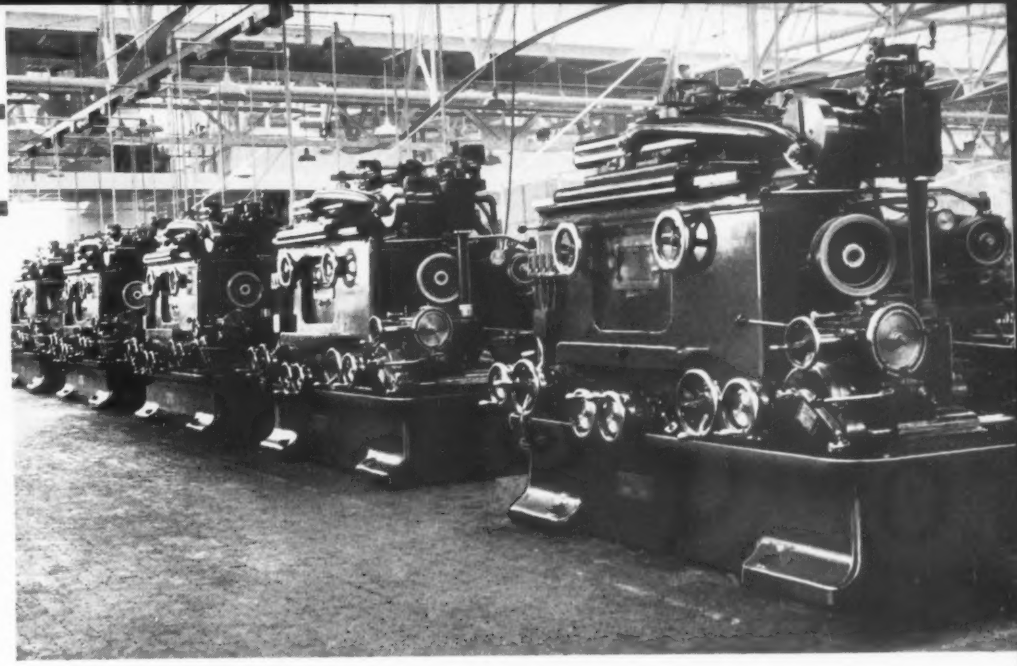


Fig. 7. (Right) Battery of Five Lees-Bradner Machines Used for Grinding Teeth of Gears for P & W Engines

Fig. 8. (Center) Equipment Employed in Honing the Six Pairs of Knuckle-pin Holes in Master Rods to Two Different Sizes

seen at the right for ready substitution on the spindle of the machine. Each tool is provided with its own pilot sleeve which fits into bushings mounted in the jig plate and thus insures accurate guidance of the tool. The use of a radial drilling machine enables the spindle to be quickly shifted to the different holes being drilled or reamed.

The teeth of all external spur gears used in engines built in this plant are ground either in Lees-Bradner or Pratt & Whitney machines. Five machines of the former type are seen installed in a row in Fig. 7. A battery of four Pratt & Whitney two-wheel gear-tooth grinding machines is illustrated in Fig. 9.

Barnes honing machines are employed for the final finishing operation on the wrist-pin and knuckle-pin bearings of master rods. Fig. 8 shows a set-up used for honing the knuckle-pin bearings. The fixture is so designed as to enable all six pairs of knuckle-pin bearings to be indexed into line with the honing spindle. One knuckle-pin hole of each pair is honed to a diameter of between 1.0637 and 1.0641 inches in the operation shown, and the other hole to between 1.0587 and 1.0591 inches, the hone being provided with two sets of abrasive stones to suit the two diameters.

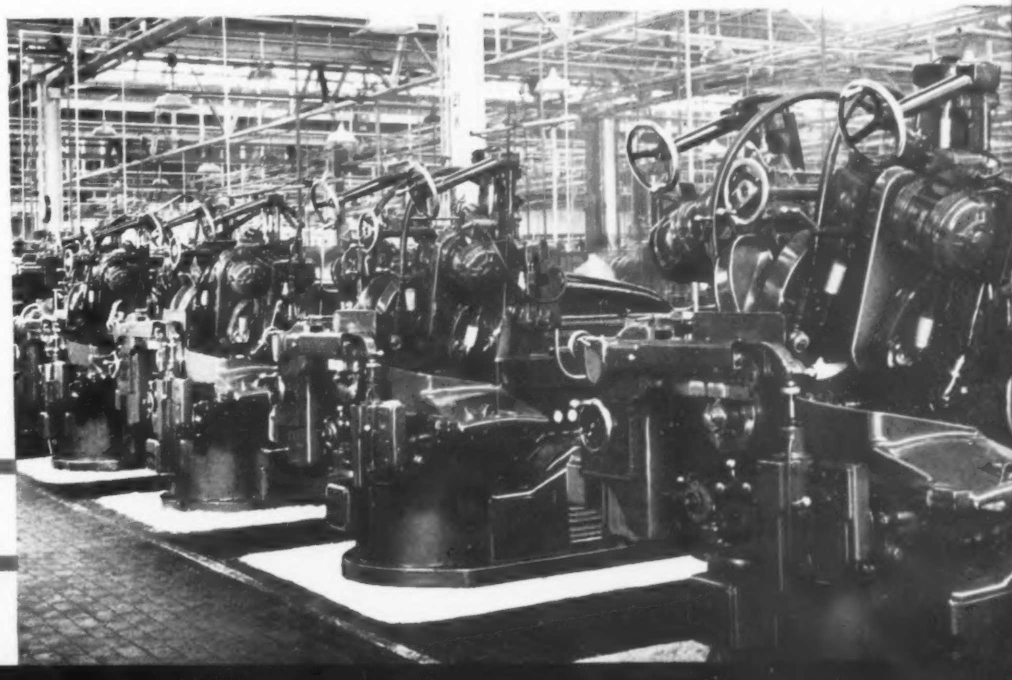
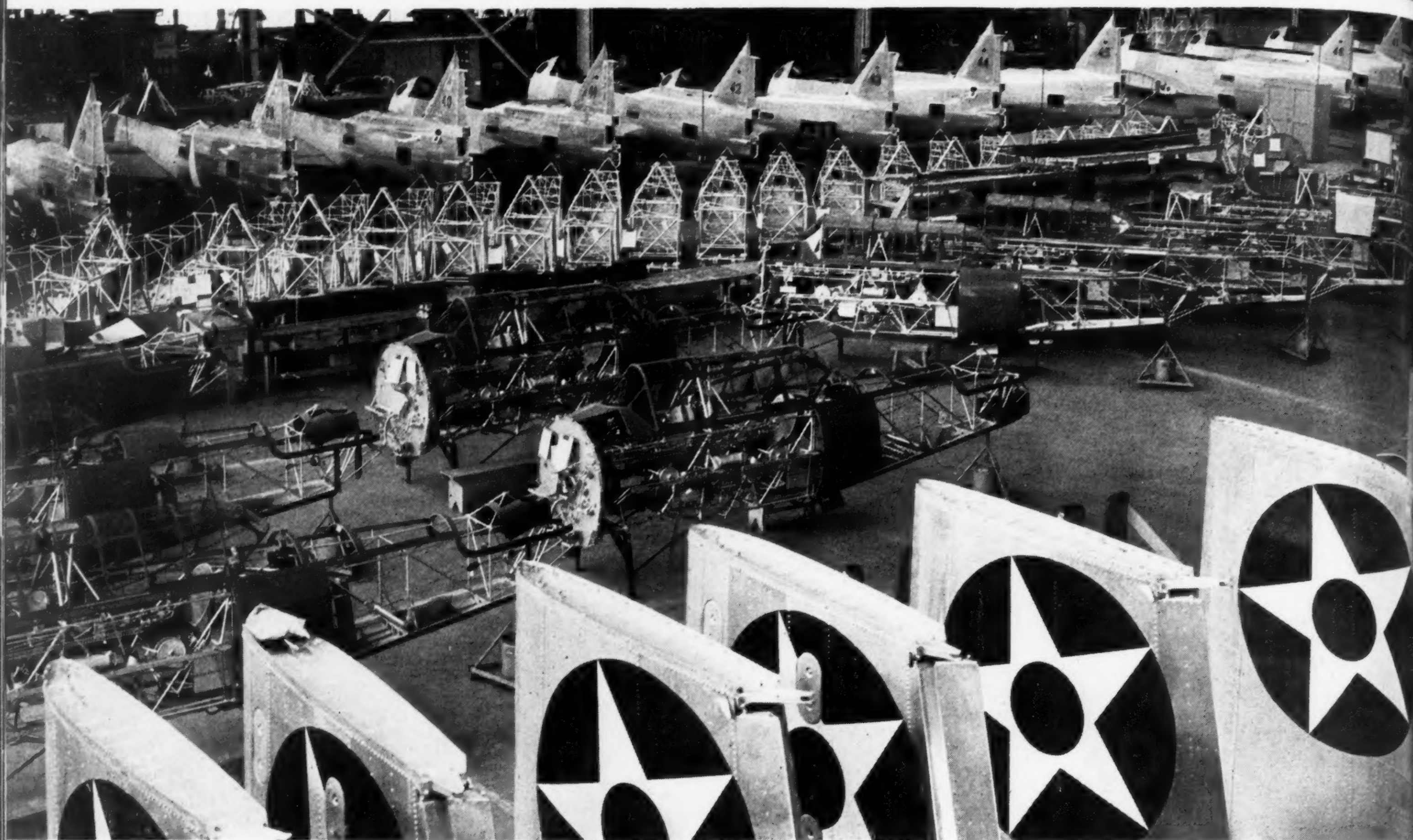


Fig. 9. Battery of Pratt and Whitney Two-wheel Grinding Machines Used in Finishing the Teeth of Gears for Aircraft Engines

Military Planes by Real



THE outstanding production efficiency of North American Aviation, Inc., Inglewood, Calif., makes this plant one of the most progressive in the airplane-building industry. The entire factory is comparatively new, and was planned by men of wide experience in the building of airplanes. The original building was completed early in 1936 with a floor space of 160,000 square feet. Since that time, additions have been made that have increased the floor space to over 650,000 square feet. Approximately 5500 persons were employed on June 1.

From the very beginning, this factory was planned on the production principles of the automotive industry, and provision was made for adherence to those principles with any subsequent expansion in factory space. Plane orders in quantities considered large for the aircraft industry enabled the development of the methods followed.

Parts and sub-assemblies are made either on mezzanine floors, from which they can be readily transferred to the final assembly lines on the main floor, or in departments to the right and left of the main assembly lines. On the assembly floor, the planes are advanced progressively from the beginning to the end of the line in a manner similar to automobile production.

At the beginning of each line, the fuselage sections of a plane are assembled with the front end mounted on light structural stands and the tail end on a three-caster truck. When the plane has been assembled to the point where it is ready to be moved to the next position along the line, the front end can be readily raised by a lift truck, and the assembly pulled forward on the caster and lift trucks. As a plane reaches the successive stations along the line, the engine is mounted, the wings attached, the wheels assembled, etc., and the completed plane is towed away from the end of the line ready for engine runs and test flights. A section of the assembly floor is shown above. There are twelve assembly lines in constant operation.

Production Methods

The facilities of this plant are devoted to the production of small- and medium-sized military planes of both fighting and training types. Included among these products is a two-place basic trainer which can also be equipped for combat operation or light bombing; an advanced combat and utility plane; a single-seat fighter; an observation plane; and a light attack dive bomber, all of these planes being of single-engine design. In addition, there is a bomber powered with two engines and manned by a crew of five.

In airplane-manufacturing plants, lack of adequate machine shop facilities has proved a frequent bottle-neck in production. In order to be able to keep a close control of the accuracy of machined parts, and maintain the production of machined parts according to schedules, the management of North American Aviation, Inc., from the very beginning, planned for a well equipped and efficiently operated machining department. Typical operations in the machine shop are described in this article.

A Keller automatic tool-room machine being used for the milling of two prototype landing gear struts of right- and left-hand styles from billets of forged duralumin is shown in Fig. 1. This is an instance where the struts were required for a new landing gear design with minimum delay, and about four months would have elapsed before forgings of approximate dimensions could have been obtained, due to the time required for producing the dies, etc. With the Keller machine, the struts could be quickly produced for the first plane models. Regular forgings were, of course, made for the later planes produced in quantities.

The rough billets from which the two landing gear struts were produced had an original weight of 75 pounds, whereas the finished struts weighed only 10 pounds each. This indicates the large amount of stock removed in the operation. The work-plate of the machine measures 20 inches high by 36 inches long, not including, of course, the upper plate on which the templets are mounted. The most novel application of this machine is in the production of wind-tunnel plane models, which are made from magnesium castings, an operation that could not be illustrated because of the secrecy which is maintained concerning all new plane models. The Keller automatic tool-room machine is

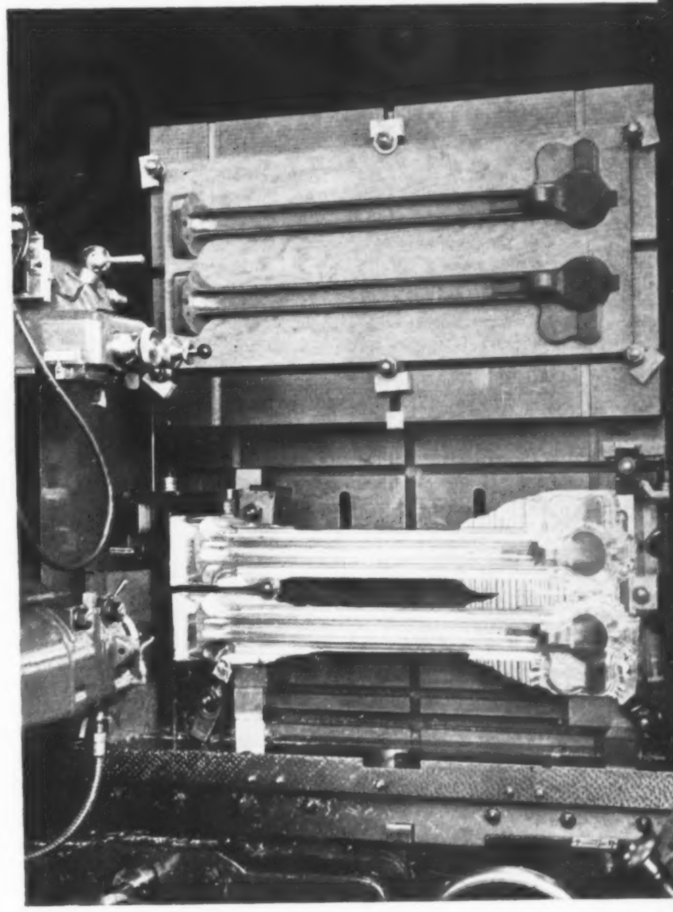


Fig. 1. Producing Prototype Landing Gear Struts from Forged Duralumin Billets on a Keller Automatic Tool-room Machine

Fig. 2. Boring a Hydraulic Cylinder for Landing Gears in a Lathe with a Long Boring-bar Held between Headstock and Tailstock

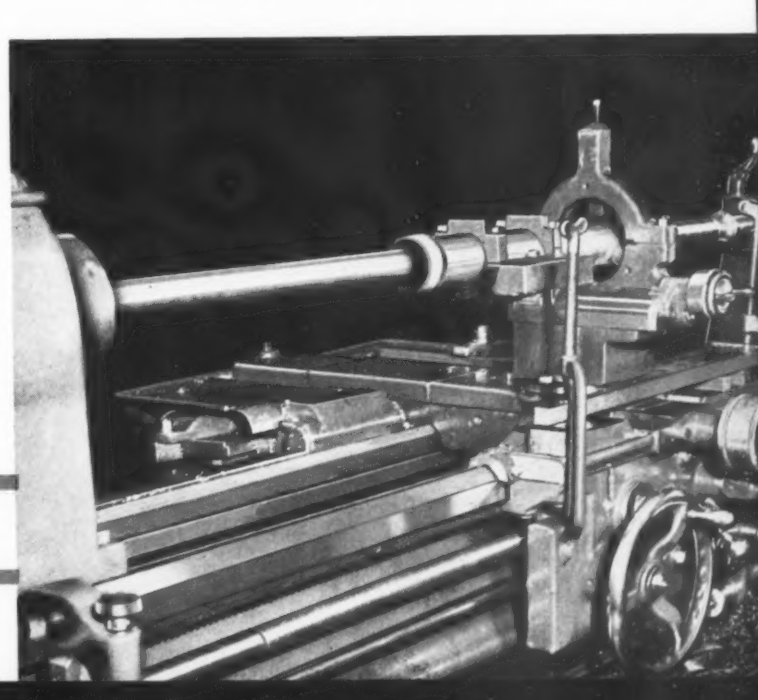


Fig. 3. (Above) Surface Grinding 100 Parts Held on a Magnetic Chuck. Fig. 4. (Below) Precision-boring Holes at Right Angles to Each Other

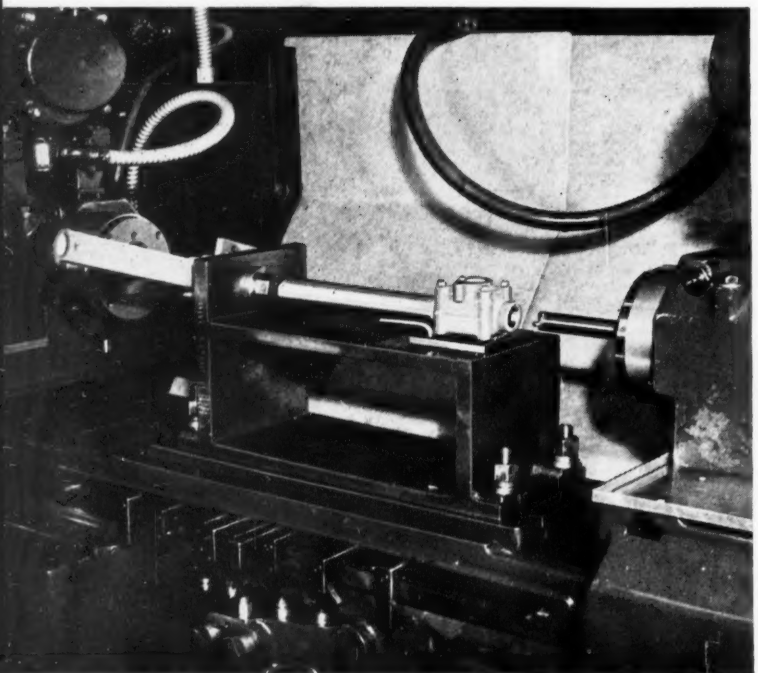
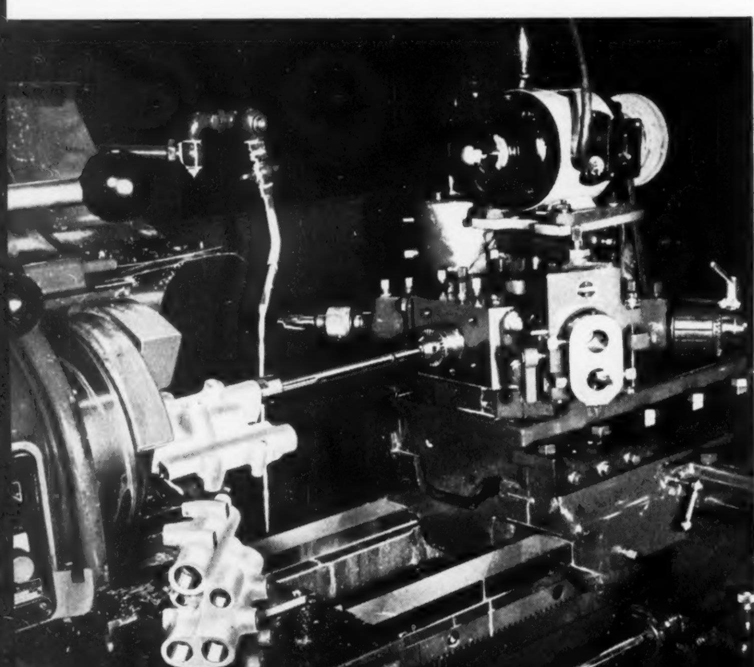


Fig. 5. (Below) Turret Lathe Tooled up for an Operation of Extreme Accuracy in the Machining of Hydraulic Selector Valve Castings



also used on quantity production orders and for tool-room work.

The unusual lathe set-up illustrated in Fig. 2 is employed for boring landing gear hydraulic cylinders, 27 1/2 inches long, from chromium-molybdenum steel tubing on a Monarch engine lathe. In order to maintain the bore diameter within a tolerance of plus or minus 0.002 inch, the tubing is mounted on a special block on the lathe carriage, and is given additional support by a steadyrest. One end of the boring-bar is attached to the headstock chuck and driven by the machine spindle, the other end being supported by the tailstock.

In operation, a roughing cut is taken to a depth of 1/8 inch as the carriage feeds toward the headstock, and also a finishing cut, in which stock to a depth of 0.005 inch is removed. After removal from the lathe, the bore is honed to a high finish.

The operation shown in Fig. 3 consists of grinding flat parallel bases on parts held on the circular magnetic chuck of a Blanchard surface grinding machine. One hundred work-pieces are handled at one time. The chuck is 30 inches in diameter.

Two operations are performed with the Ex-Cell-O precision boring machine illustrated in Fig. 4 by mounting two flap control parts at one time on the work-fixture. These flap control parts are cast in two pieces and bolted together before coming to the boring machine, the joint faces having been previously finished on a disk grinder. The castings are of duralumin.

Each part is mounted horizontally on the fixture, as seen at the right, for boring a bearing 1.125 inches in diameter with tools on the right-hand boring-head. The part is accurately located by seating previously drilled and reamed bolt holes of the flange on dowel-pins projecting upward from a steel plate that is clamped to the fixture by operating a small handle. Tungsten-carbide tools take roughing and finishing cuts.

The part is then transferred to the left-hand end of the fixture for boring a hole the same size in the same end of the work but at right angles to the bore just finished. The dowel-plate on which the part was mounted for the first step in the operation is transferred with the work for holding the part in the second step. A tolerance of plus 0.0004 inch minus nothing is specified on the two holes, and one of them is machined to a shoulder, the distance of which from the end of the piece must be held within plus or minus 0.002 inch.

This is an instance where a modern type of ma-

chine has not only reduced machining time, but has also eliminated work rejection, which formerly ran as high as 40 per cent when drilling, boring, and reaming were performed, due to distortion of the comparatively light castings.

The machine shop equipment includes a battery of turret lathes. Fig. 5 illustrates a typical operation on a Jones & Lamson machine of this type, which consists of machining two holes, 6 inches long, in hydraulic selector valve castings of duralumin. A fixture is used on the headstock, which is equipped with a slide that enables the work to be shifted radially after one hole has been completed, so as to bring the second hole in alignment with the headstock spindle. Drilling, reaming, boring, counterboring, and tapping cuts are taken on each hole, all with tools mounted on the turret. The 6-inch long holes must be machined to a nominal diameter of 0.500 inch within plus 0.0005 inch minus nothing.

The drill spindle is driven by a separate motor, mounted on the turret, at a speed of about 400 R.P.M. This combination of revolving the work and the drill produces a smooth straight hole.

The machine shop also includes an extensive milling department, in which there are seventeen Cincinnati milling machines. One of these machines, of the horizontal spindle type, is shown in Fig. 6 performing a typical slab-milling operation on a duralumin forging held in a fixture designed for quantity production. In operations of this type, cutter speeds can be used up to about 500 R.P.M. with a cutting depth of 3/8 inch, a width of 2 1/2 inches, and a feed of 15 inches per minute.

Fig. 7 shows a Van Norman milling machine being used for milling the edges of steel die-plates to required angles by tilting the milling head and using the side of an end-mill. By positioning the work at an angle with respect to the length of the table, the edge of the plate is machined to a compound angle in one cut. The die-plates are milled to different angles along the front, back, and sides.

One of the smaller machines in the shop is the Hardinge precision hand screw machine seen in Fig. 8 set up for producing small tools employed in "dimpling" sheets to receive the flush heads of rivets. The dimpling tools are held one at a time in the end of a mandrel that is gripped in the collet chuck of the headstock. Angular facing cuts are taken by the tool on the cross-slide, after which drilling operations are performed with drills mounted on the turret.

Fig. 6. (Above) Production Milling Operation on an Aircraft Forging. Fig. 7. (Below) Milling Die-plate Edges on a Universal Milling Machine

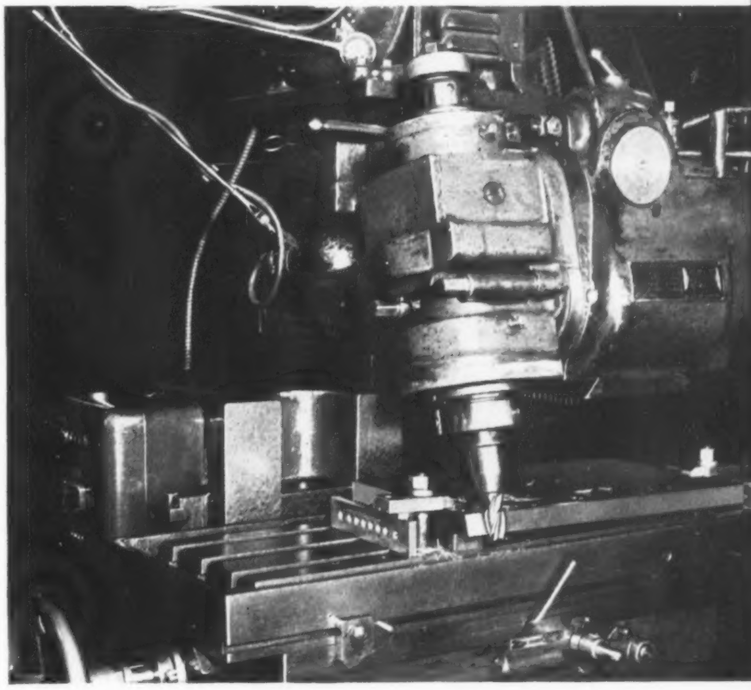


Fig. 8. (Below) Precision Hand Screw Machine Employed for Drilling and Taking Angular Facing Cut on Dimpling Tools

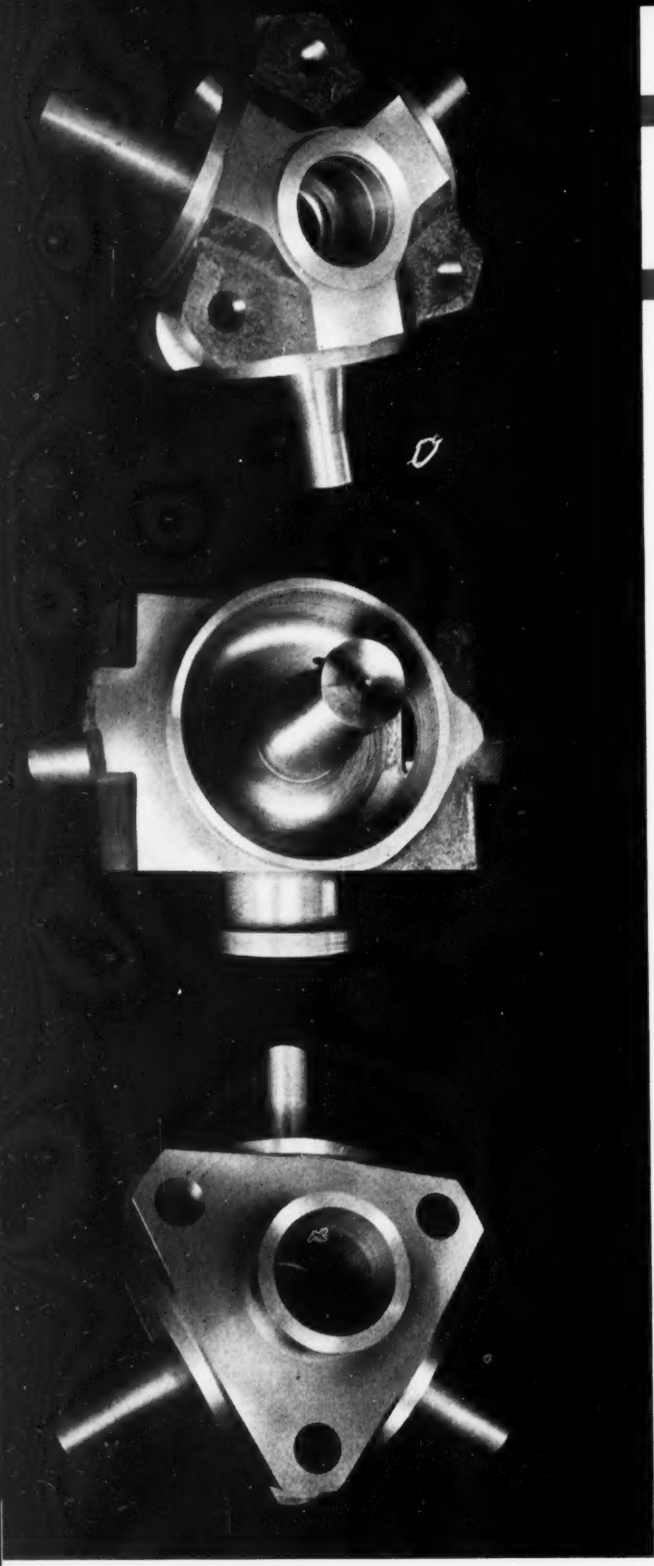


Fig. 1

Automatics

THE versatility of automatic chucking and turning machines that enables them to perform a large variety of operations with one handling of the work has proved especially advantageous for the machining of three-blade propeller hubs in a French airplane engine plant. These propeller hubs are one-piece solid steel forgings that weigh approximately 210 pounds when they reach the first machine in a battery of Potter & Johnston automatics. When the propeller hubs leave the last automatic of this battery their weight is only 118 pounds.

Several batteries of Potter & Johnston automatics are used on these propeller hubs. Practically all the operations, with the exception of cutting the internal splines and grinding, are performed by the automatics. The detail views in Fig. 1 show the appearance of the propeller hubs when they leave these machines, and clearly indicate the large amount of stock removed by them. Dimensions of the finished propeller hubs are given in Fig. 3.

In the operations performed on the ends of the hub forgings, the work is rotated in one position only, but in machining the arms and the three holes drilled and bored through the forging at right angles to the arm axes and at points equidistant between the arms, it is necessary to index the work into three different positions. Fixtures of special design insure adequate support of the work in all operations and precision indexing.

The successive operations performed by the automatics are shown by photographs that appear on the following left-hand pages and diagrams directly opposite on the right-hand pages that identify the surfaces machined in each operation.

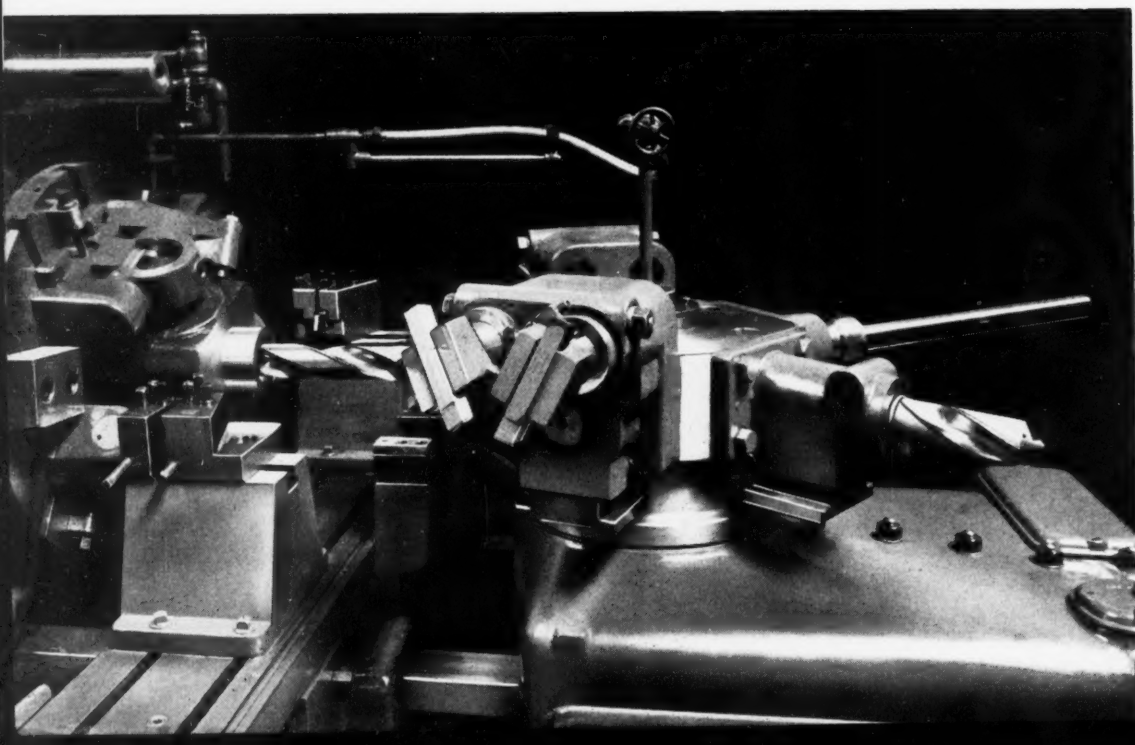


Fig. 2

In all the operations performed by the automatics, accurate alignment of the turret tools with the work and maximum rigidity are insured by the engagement of rectangular pilot surfaces on the turret tool-blocks with guides at the top of a bracket attached to the cross-slide base.

In the first operation, the hub forging is approximately centralized and also supported by two stop-screws which register between the arms. The three arms are located in V-blocks, two of which are floating and one fixed. Clamps on the V-blocks are swung into position and a set-screw tightened against each arm.

The long end of the propeller hub is turned and faced, also on Potter & Johnston automatics, before the part goes to the second operation. For the second operation (see Fig. 8), the hub is seated on the finished face with bore *A* located on a hardened and ground bar. Radial location of the arms is obtained by entering hand-operated centers into center-holes in the ends of two arms. The work is clamped by tightening a nut and washer on the top end of an arbor that extends into the upper end of bore *A*.

The arms are similarly located for the sixth operation. However, in this case, the main bore of the hub is splined prior to the operation and a bushing is slipped into the splined end for locating the work accurately in the headstock fixture by means of a bar that is entered into the bushing. The hub forging is also located from the splined bushing for the seventh operation, in which case, however, the short hub is positioned toward the spindle.

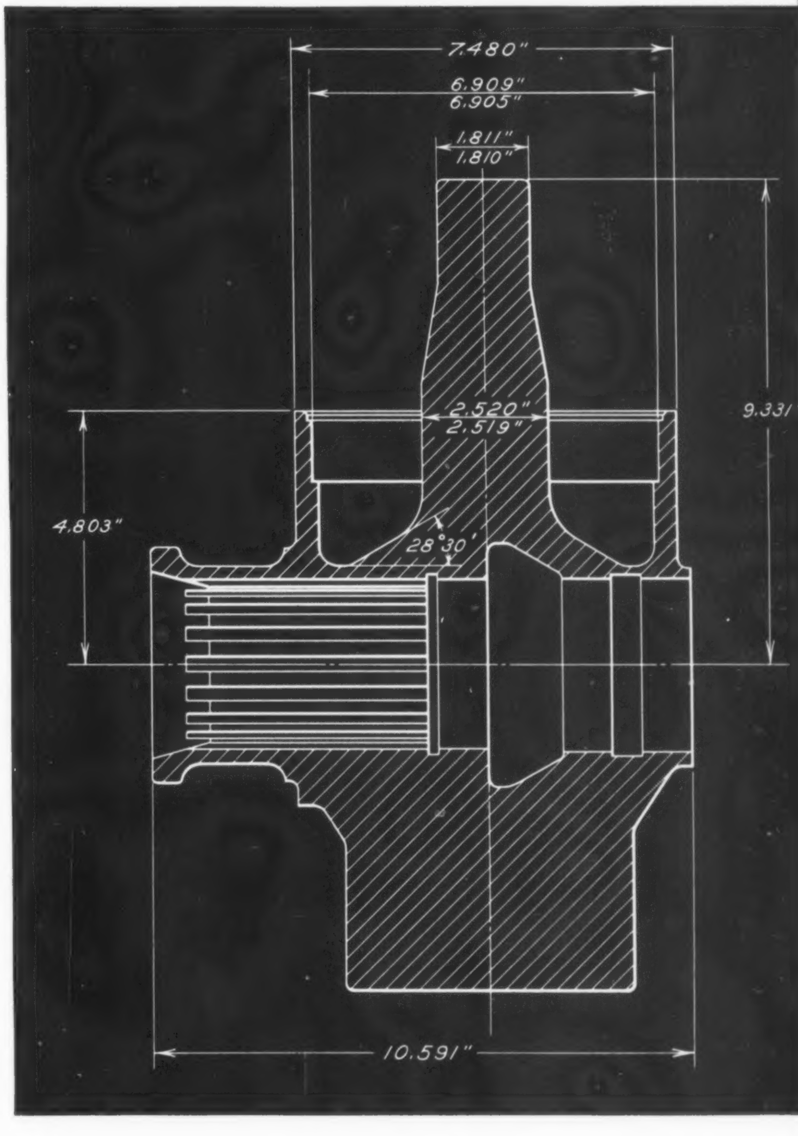
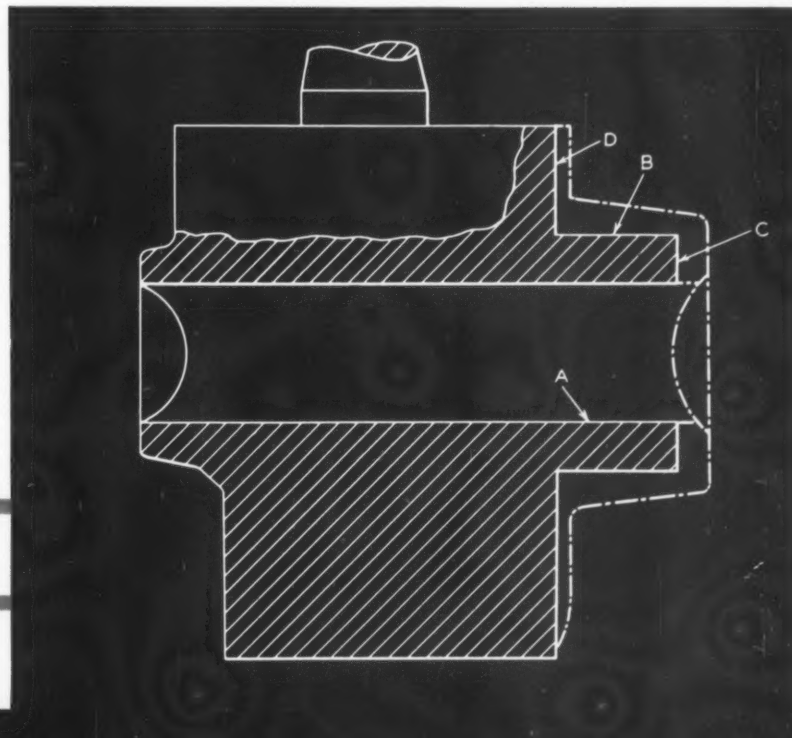


Fig. 3. (Above) Fig. 4. (Below)



First Automatic Operation

(1) Spot-drill hole *A* to a depth of about 2 1/2 inches with a drill on the first turret face, seen extending toward the right in Fig. 2. (2) Rough-turn surface *B* with tools mounted on the second turret face, and at the same time rough-face surfaces *C* and *D* with tools on the front of the cross-slide. (3) Drill hole *A* completely through with a tool on the third turret face. (4) Bore hole *A* and finish-turn surface *B* with tools on the fourth turret face, at the same time finishing faces *C* and *D* with tools mounted at the rear of the cross-slide. (5) Ream hole *A* to 68 millimeters (2.677 inches). Average floor-to-floor time per part, 64 minutes.

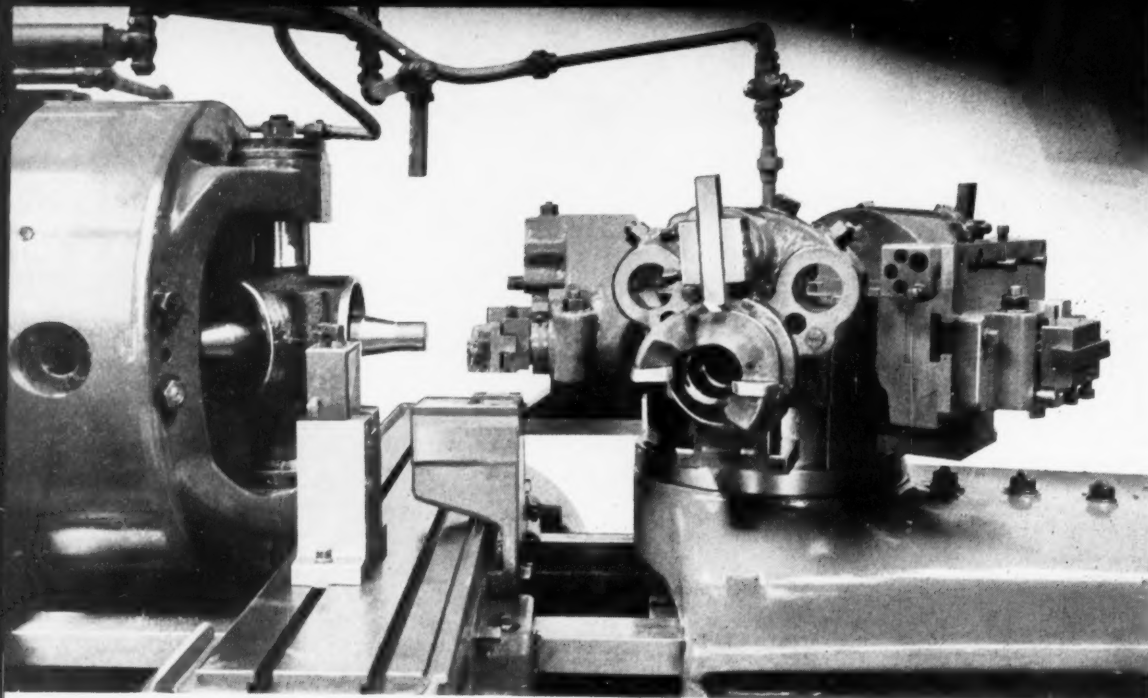


Fig. 5. (Above)

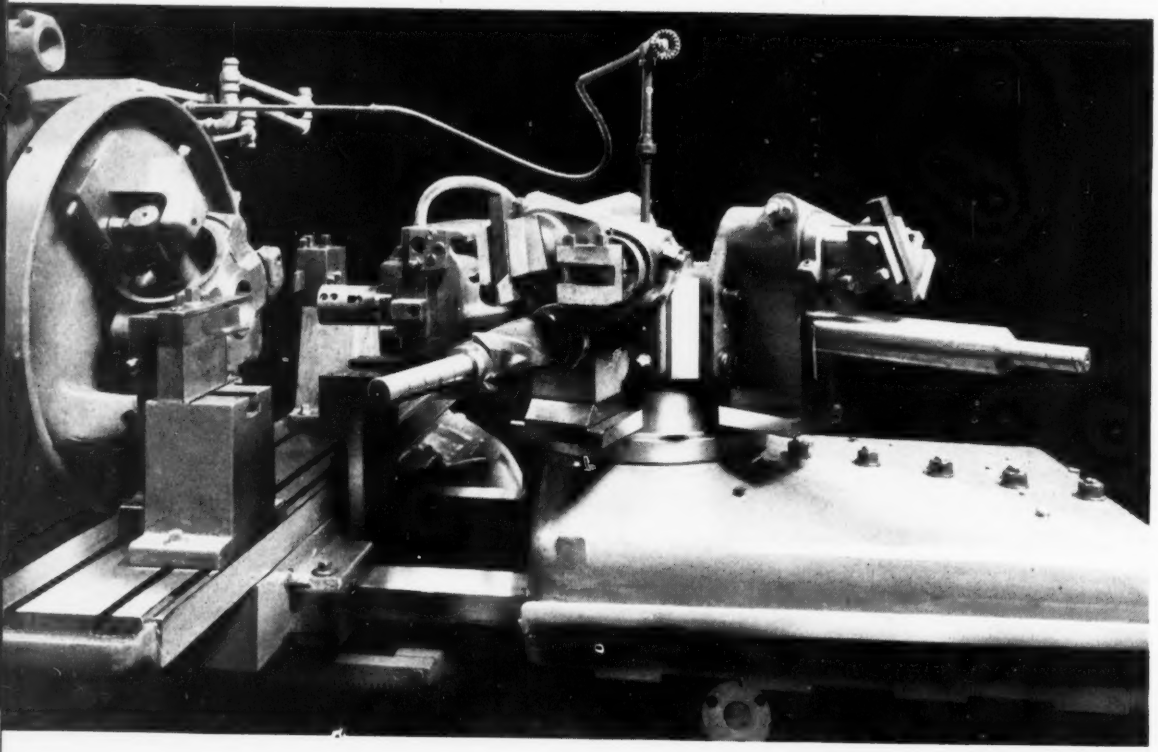
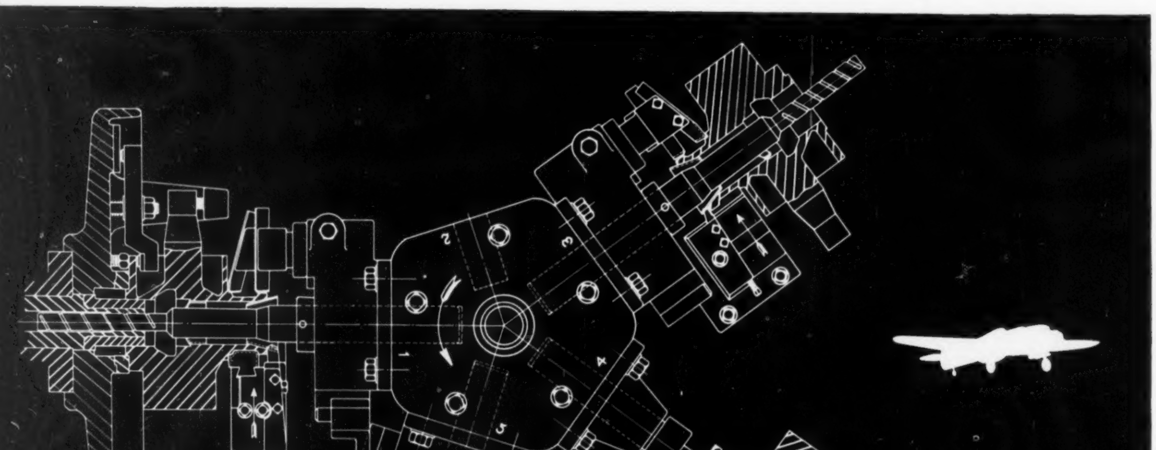


Fig. 6. (Above) Fig. 7. (Below)



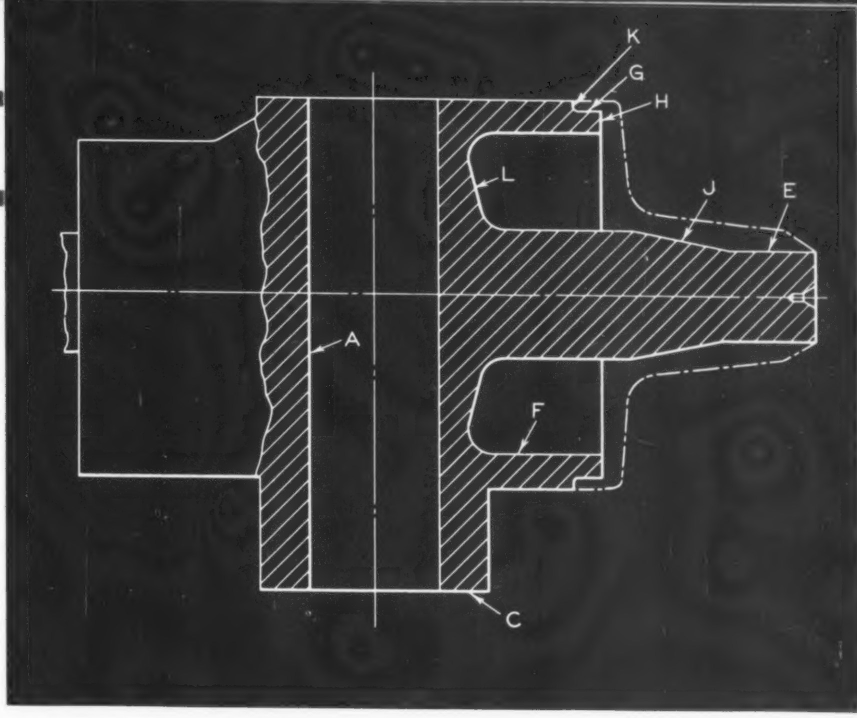


Fig. 8. (Above)

Second Automatic Operation

(1) Turn end *E* of arm with tool on first turret face. (2) Rough-trepan bore *F* to a depth of about 1 1/2 inches and rough-turn surface *G* with tools on the second turret face, at the same time rough-facing end *H* with a tool on the front of the cross-slide. (3) Rough-trepan bore *F* to a depth of about 2 1/2 inches with cutters on the third turret face. (4) Rough-turn taper *J* and finish-face end *H* and shoulder *K* with tools mounted on the fourth turret face. In turning the taper surface, the tools are fed sidewise as the pilot at the bottom of the tool-block moves along cam-like surfaces in the guide attached to the cross-slide base. (5) Trepan surface *L* at bottom of bore *F* with tool on fifth turret face. Time for all three arms, 4 hours 36 minutes.

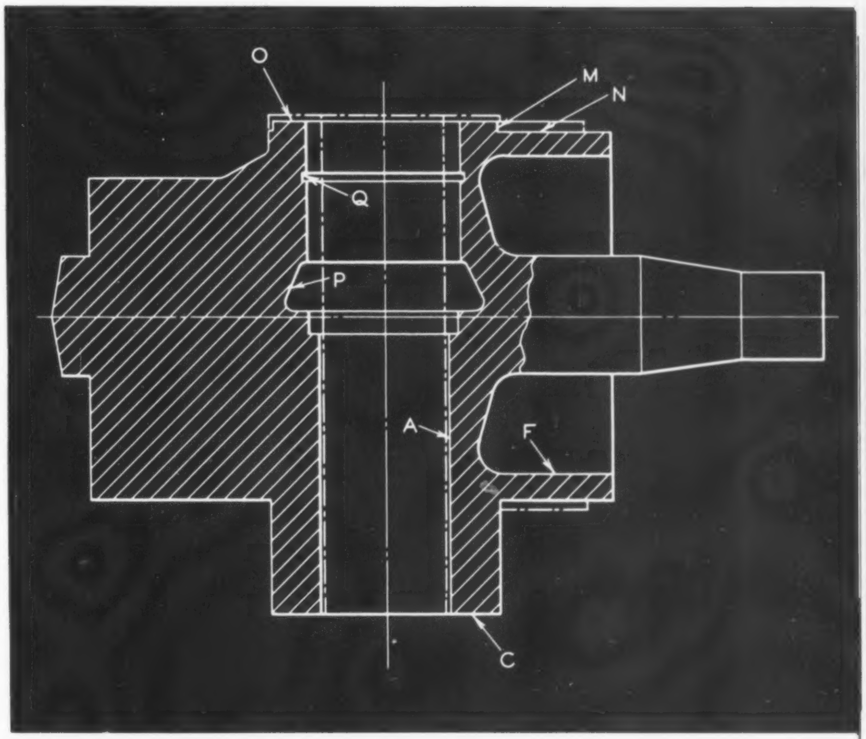
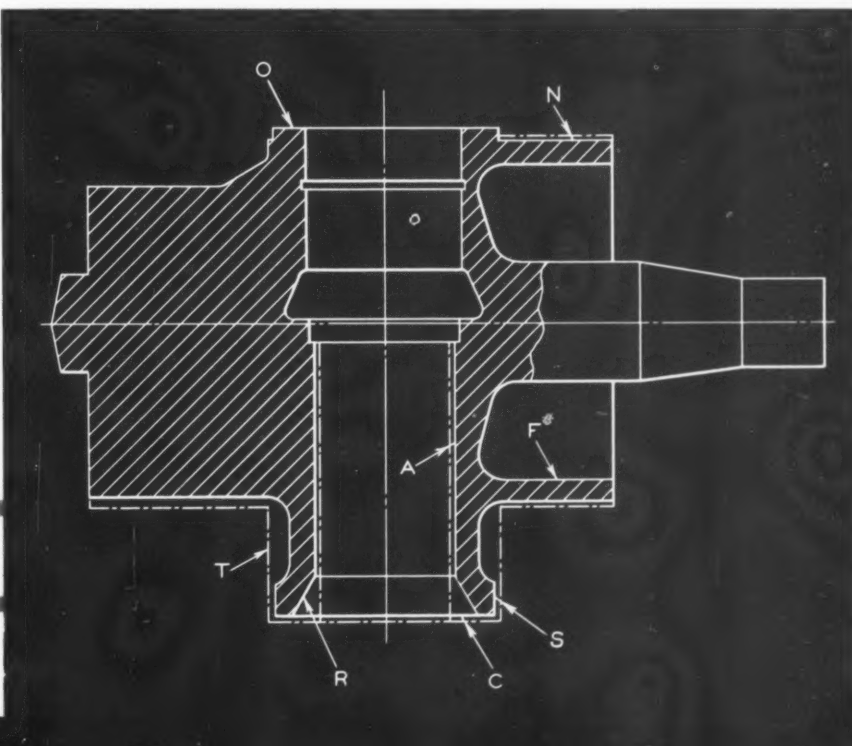


Fig. 9. (Above) Fig. 10. (Below)

Third Automatic Operation

The forging is located in the headstock fixture by seating bore *A* on a plug, and is clamped against face *C* by tightening three hand-operated clamps against the rough-bored surface *F*. The sequence of the operation is as follows: (1) Rough-bore hole *A* to a depth of 4 9/16 inches and rough-turn surface *M* with a tool mounted on the first turret face, at the same time facing end *O* and surface *N* with tools on the front of the cross-slide. (2) With a slide tool mounted on the second turret face, rough-form recess *P* and groove *Q*. (3) Finish-turn surface *M* with a tool on the third turret face, and at the same time face surface *N* with a tool at the rear of the cross-slide. (4) Size-turn surface *M* with a tool on the fifth turret face. Average floor-to-floor time per part, 1 hour 11.6 minutes.



Fourth Automatic Operation

(1) Rough-bore hole *A*, rough-bore the 15-degree taper *R*, rough-turn surfaces *S* and *T* with tools on the first turret face, at the same time rough-facing end *C* and forming back of diameter *S* with tools mounted on the front of the cross-slide. (2) Finish-bore hole *A* and tapered hole *R* and finish-turn surface *S* with tools mounted on the third turret face, at the same time finish-facing end *C* and forming back of diameter *S* with tools mounted on the rear of the cross-slide. (3) Ream hole *A* with a tool mounted on the fourth turret face. (4) Size-turn surface *S* with a tool mounted on the fifth turret face. Floor-to-floor time per part, 1 hour 40 minutes.

AUTOMATICS IN

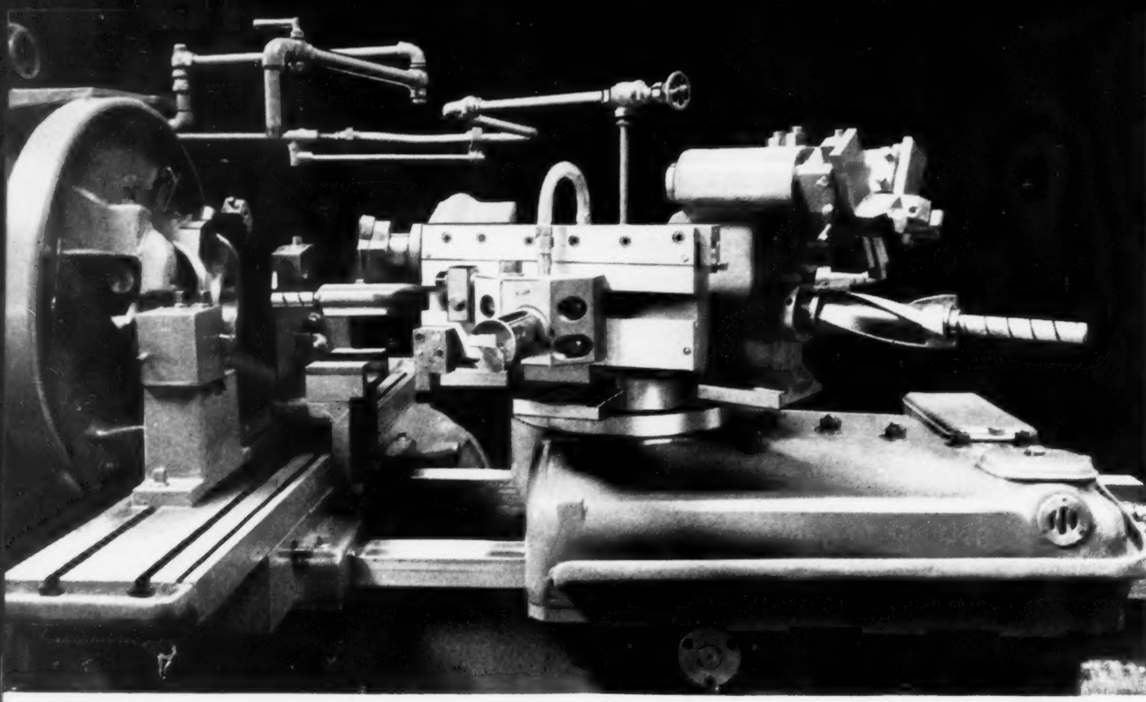


Fig. 11. (Above)

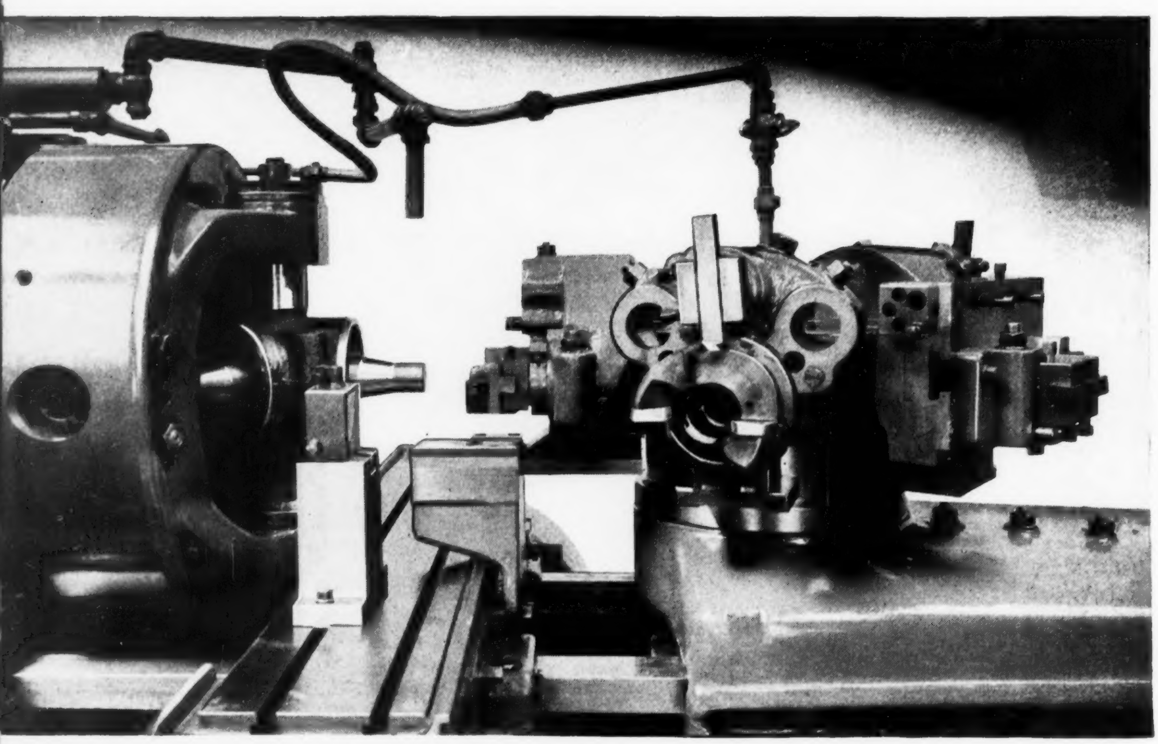
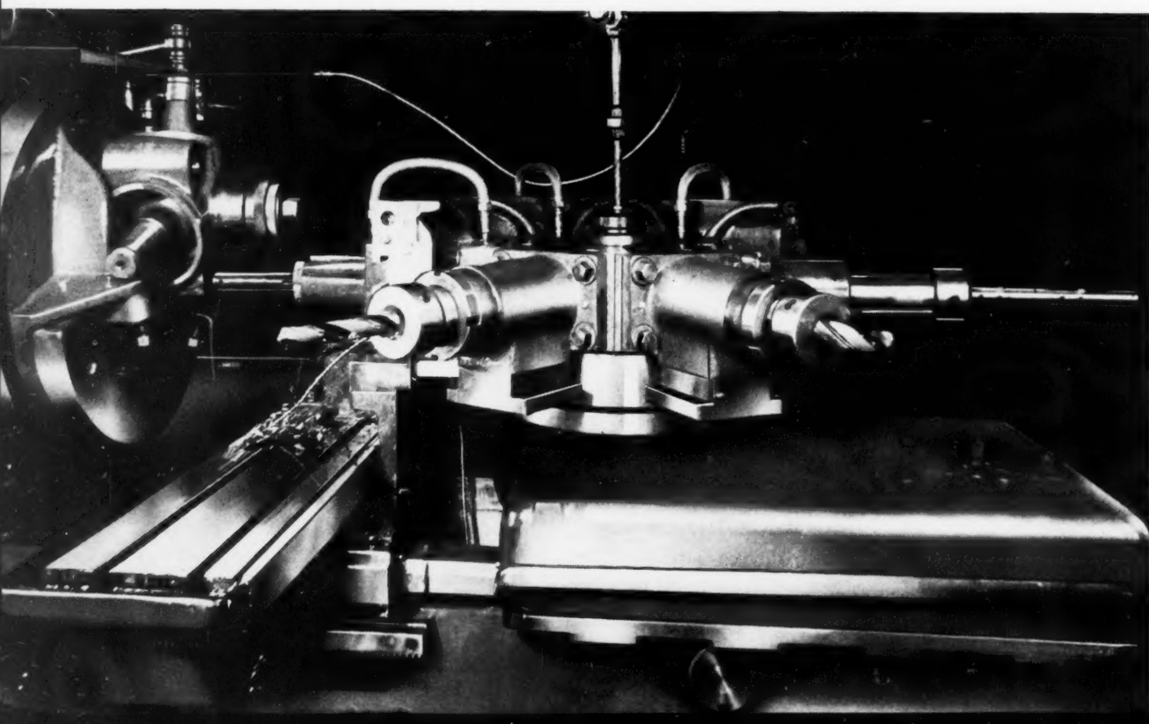


Fig. 12. (Above) Fig. 13. (Below)



Fifth Automatic Operation

For this operation, the propeller hub is located in the headstock fixture on surface *S*, and is clamped against the finished face *C* by means of three hand-operated clamps applied in bore *F*. The sequence of the operation is as follows: (1) Semi-finish holes *U* and *V* with tools on the first turret face. (2) Machine three grooves and recess *P* in bore *A* with tools mounted on the second turret face. (3) Finish-bore surfaces *U* and *V* of the central hole with tools mounted on the third turret face. Average floor-to-floor time per part, 56 minutes.

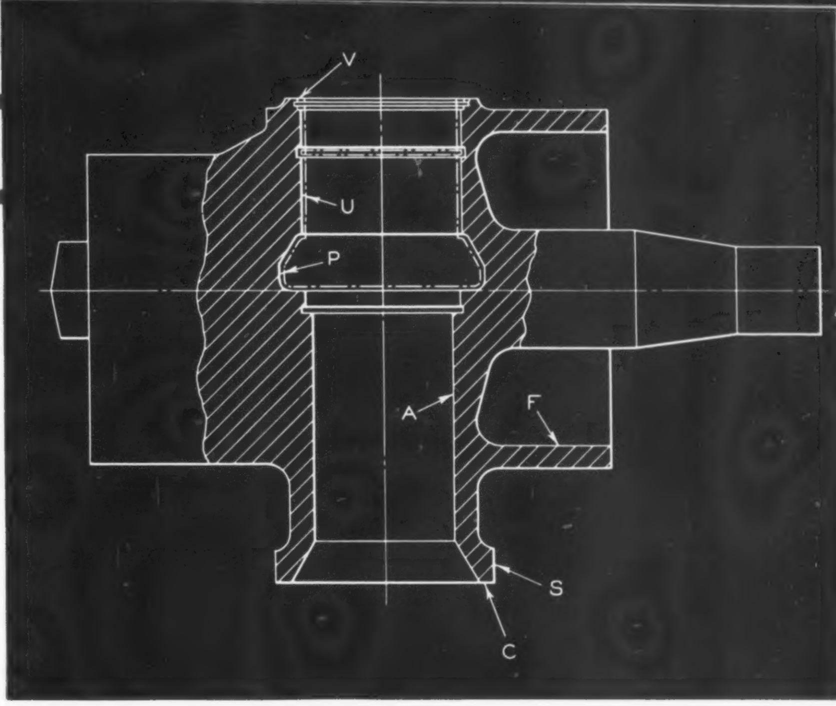


Fig. 14. (Above)

Sixth Automatic Operation

(1) Rough-turn surfaces *E* and *W* of arm and rough-bore surface *F* with tools mounted on the first turret face. (2) Finish-form surface *L* and chamfer outer corner of surface *X* with tools mounted on the second turret face, at the same time semi-finish facing end *H* and shoulder *K* with tools mounted on the front of the cross-slide. (3) Finish-turn surfaces *E* and *W*, and the taper between with tools mounted on the fourth turret face, and finish-face end *H* and shoulder *K* with tools on the back of the cross-slide. (4) Bore surfaces *F* and *X* with tools mounted on the fifth turret face. The average floor-to-floor time for performing these cuts on all three arms of a propeller hub is 4 hours 17 minutes.

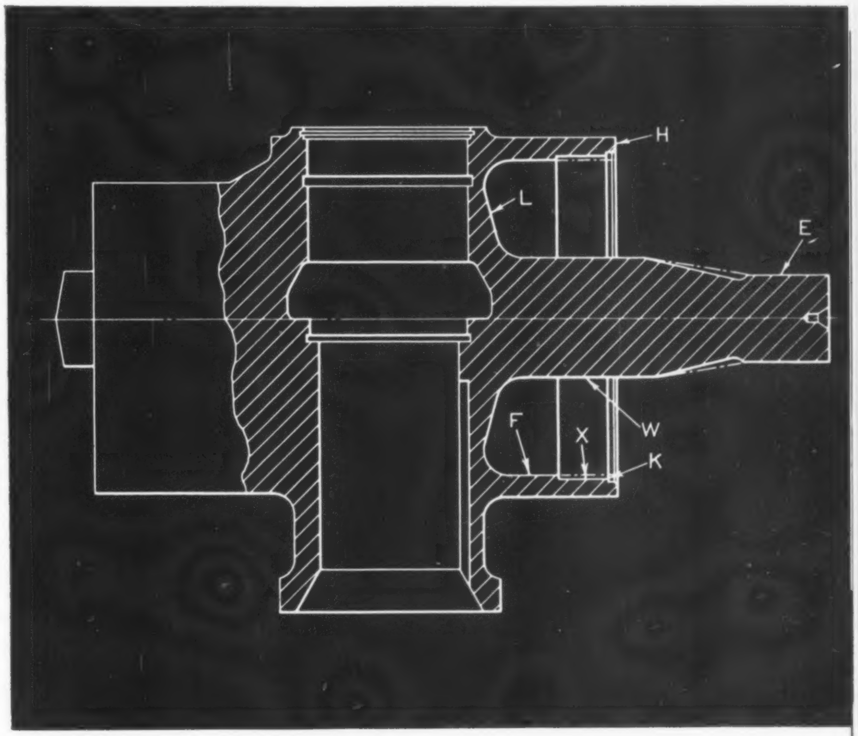
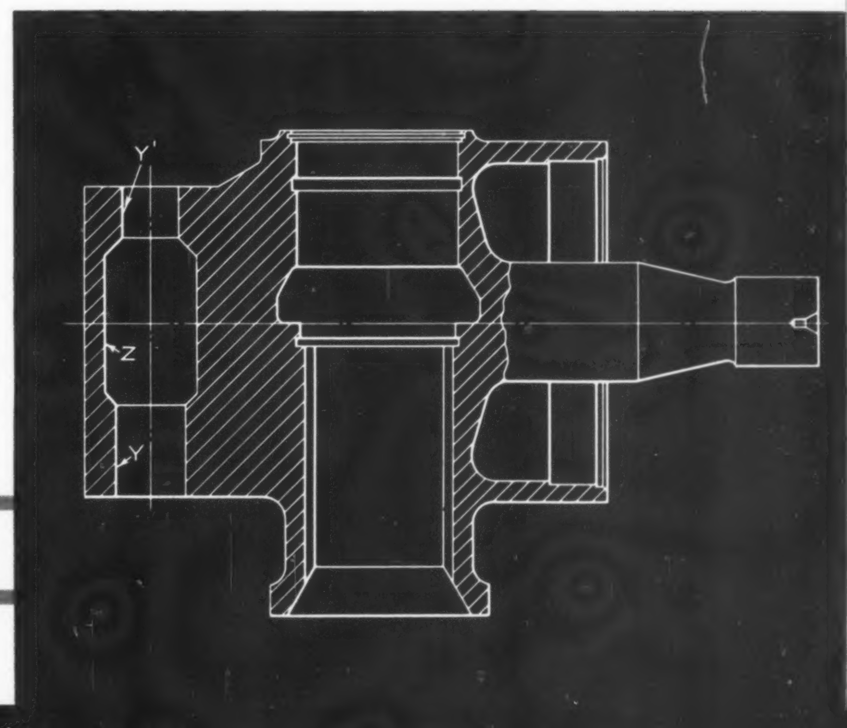


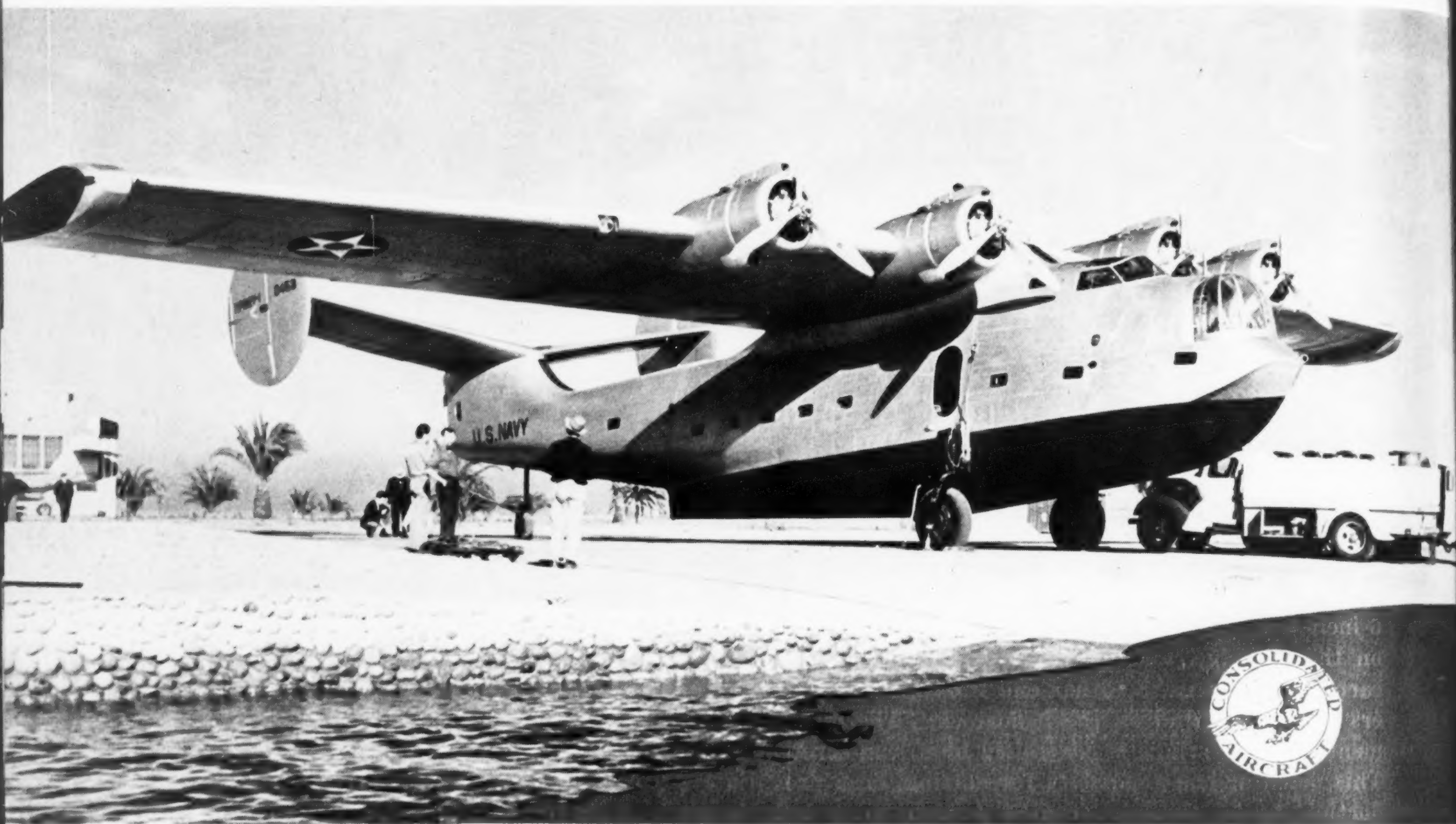
Fig. 15. (Above) Fig. 16. (Below)

Seventh Automatic Operation

(1) Rough-drill hole *Y* to a diameter of 1 7/16 inches for a depth of 3 3/8 inches with a tool on the first turret face. (2) Rough-drill a hole about 1 5/32 inches diameter through the entire forging with a tool on the second turret face. (3) Rough-bore recess *Z* with a tool on the third turret face. (4) Semi-finish bore recess *Z* with a tool on the fourth turret face. (5) Finish-bore recess *Z* with a tool on the fifth turret face. (6) Finish-bore and ream holes *Y* and *Y'*. Floor-to-floor time in machining all three holes, 5 hours 30 minutes.



Consolidated—Biggest Builder of



THE Consolidated Aircraft Corporation, San Diego, Calif., is famous for its pioneer work in the development of long-range flying boats. Recently it produced the world's largest amphibian. Mighty planes of the United States Navy—four-engined bombers—as well as the Navy's fleet of more than 200 twin-engined patrol bombers (PBY) have also been built by Consolidated. In the commercial field, the concern made a noteworthy contribution to aviation by the construction, in 1939, of a fast, long-range flying boat capable of carrying fifty-two passengers, which is propelled by two Wright engines of 2000 H.P. each.

The latest Consolidated development is a bombardment airplane for the United States Army Air Corps, which is driven by four radial air-cooled engines of 1200 H.P. each that give it a speed of over 300 miles an hour. Thus large land planes have been added to the line of flying boats made by the concern, and it is now engaged on important contracts for supplying military planes to the British and French air forces.

Vast changes have occurred in aircraft building during the seventeen years that have passed since the founding of this concern. The airplanes of those days, constructed in large part of wood and fabric, have now been superseded by planes in which the only wood is the top of the navigator's table. This is made of wood solely to permit the use of thumb-tacks for holding down maps. The fabric covering on modern planes is now confined almost entirely to the movable control surfaces.

Five years ago, the concern moved from its Buffalo, N. Y., plant to San Diego, where buildings had been erected and equipped to provide advanced manufacturing facilities. With the completion of current factory expansion, Consolidated will have 1,910,000 square feet of covered and uncovered manufacturing space. Yard areas paved with asphaltic concrete can be used virtually the entire year for final assembly operations, because of the mild climate. The hulls are assembled indoors in a department, the final assembly line of which is seen in the illustration on page 189. Typical manufac-

Flying Boats By CHARLES O. HERB

turing operations in this aircraft-building plant, especially in the machine shop, are described here.

In Fig. 1 is shown a Cincinnati centerless grinding machine being employed for the external finishing of chromium-molybdenum tubes for the beaching gear for the flying boats. These tubes are 3 1/2 inches outside diameter by 18 inches long. They must be of the required diameter, round, and straight within close limits. The same machine is used for grinding a large variety of other work, including bronze bushings 3 1/2 inches outside diameter by 3 inches long, and parts of smaller diameter.

The application of a Murchey threading machine for cutting threads of 7/16 inch diameter, fourteen per inch, American Standard coarse thread series, to a length of 5 1/2 inches, is illustrated in Fig. 2. The work-piece is a special aluminum-alloy stud, 6 inches in length. One end is held between jaws on the carriage, and the part is threaded as the carriage advances the other end through the chasers of the die-head on the headstock. The movement of the carriage is controlled by a lead-screw. This machine has a capacity for cutting, on a production basis, threads from 1/4 inch to 1 1/2 inches in diameter to the Class 3 fit demanded for aircraft parts.

Another threading operation which consists of cutting a No. 10 thread, thirty-two per inch, American Standard fine series, on a chromium-molybdenum-steel bolt is shown in Fig. 3. This operation is performed on a machine built by the Eastern Machine Screw Corporation. The bolt head is of rectangular shape, about 3/4 inch wide by 1 inch long, and of the same thickness as the bolt diameter. The bolt shank extends for a length of 3/4 inch. The rectangular head is held in the slotted end of a bar mounted in the tailstock chuck, the fit between the walls of the slot and the work being tight enough to grip the piece solidly. Threads from No. 4 up to 1/2 inch are cut on this machine.

Sheets of aluminum alloy are scarfed along the edges to the required taper by the Cincinnati milling machine illustrated in Fig. 4, which is equipped with a work-holding fixture that can be tilted to various degrees by merely adjusting the convex bottom surface of the fixture table backward or forward along the concave top of the fixture base. The machine is fitted with a special cutter-head of combined welded and cast construction. The cutter is 4 1/2 inches in diameter by 12 inches long, and is made with teeth of an extremely steep helix, having a generous amount of front rake and clearance. With this design, thin shearing cuts are taken

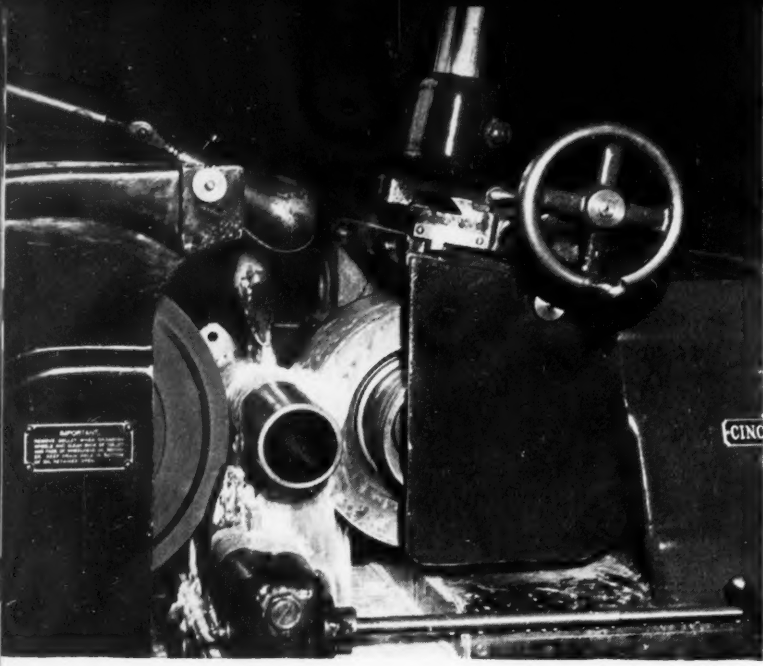


Fig. 1. (Above) Centerless Grinding Machine Finishing Tubular Shafts of Chromium-molybdenum Steel 3 1/2 Inches in Diameter by 18 Inches Long

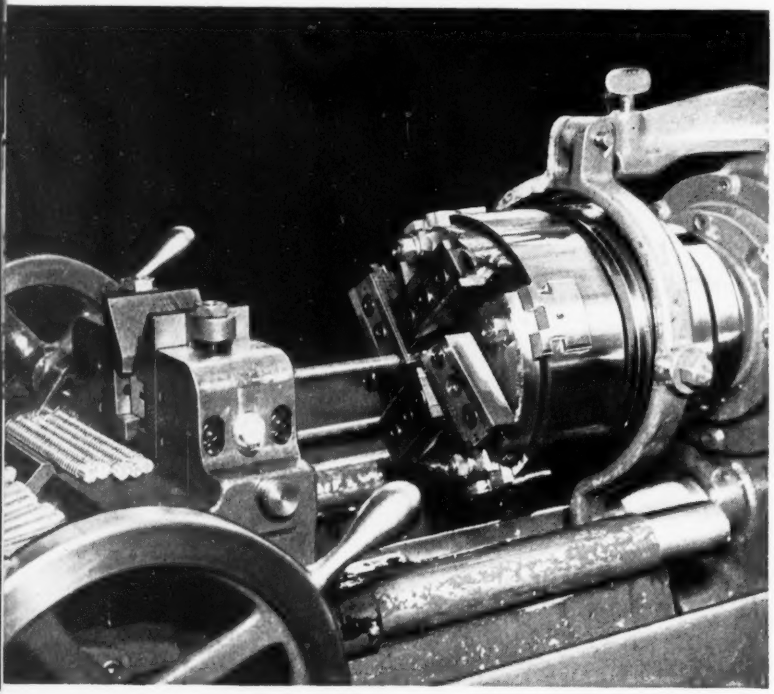
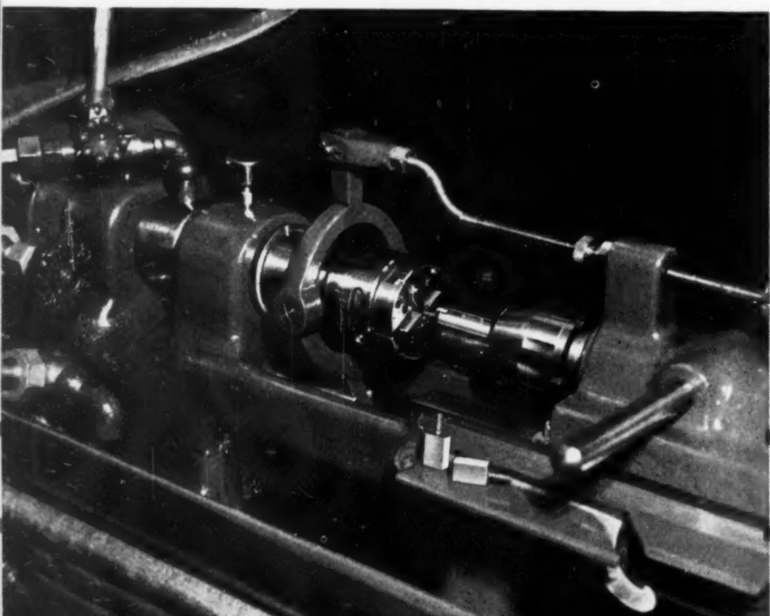


Fig. 2. (Above) Cutting Threads to a Class 3 Fit on a Production Basis. Fig. 3. (Below) Another Production Threading Operation on Small Work



without any chatter, the cutter being run at a speed of 600 R.P.M.

Sheets can be scarfed to feather edges with this equipment, the general practice being to scarf to edges about 0.010 inch thick. In operation, the work is first positioned in front of the cutter, and the table is then fed forward to a stop for the scarfing operation, after which it is withdrawn to the front position. The table is next moved longitudinally to bring a new section of the sheet opposite the cutter, and the cycle is repeated. Sheets up to 20 feet long, or as short as 1 1/2 inches, and 1/4 inch thick, are milled in this manner.

The high degree of accuracy specified on many aircraft parts is often difficult to obtain because of the light construction of the work, which makes it springy and likely to become distorted. The Ex-Cell-O precision boring machine shown in Fig. 5 has been found particularly useful in finishing work of this character. In this illustration, the machine is set up for an operation on an aluminum-alloy casting, which is bored to two diameters in each end by the cutter-heads on the opposite ends of the machine. The work is first fed to the left-hand head for boring that end of the work, and then to the right-hand head for boring the opposite end. The cutter-bar of the left-hand head is equipped with a tool, in addition to the boring cutters, for facing the left end of the casting. The total tolerance on the bores is 0.002 inch.

Many pieces of aluminum-alloy structural angles must be crimped or offset slight amounts in order to span over metal sheets or other structural shapes in assembly operations. The offsets must be produced at various angles in relation to one leg of the structural member. To meet these requirements, a joggling or offset die of the type seen on the Niagara press shown in Fig. 6 was designed with a series of slots that spread out in a fan shape from the front side of the die, so as to provide a large number of angular positions in which the work-pieces can be located for the crimping operation.

One leg of an angle to be crimped is merely seated in the proper slot. When the press is operated, two flat spring-backed blocks attached to the ram descend and bend the back end of the angle down over an offset on the die. This offset is obtained by making the die in halves lengthwise and shimming up the front die half the required amount of the offset. The slots that extend across the die-block in fan-shaped fashion, are spaced for

each 10 degrees of angle. Dies of this design are made to accommodate various amounts of offset from 0.040 to 1/2 inch.

The typical turret lathe operation illustrated in Fig. 7 consists of producing bearing collars from bars of chromium-molybdenum steel, 3 1/8 inches outside diameter. This operation is being performed on a Jones & Lamson No. 5 turret lathe. The bearing collars are 5 inches long when finished, and are machined by the turret lathe to two internal diameters.

A tool on the first face of the turret center-drills the end of the bar, while the second turret face is provided with a drill for producing the smaller hole the full length of the part. The third turret face is equipped with a drill for producing the larger diameter bore that extends about half way through the piece, while the fourth turret face is provided with a boring tool for the small hole, and the fifth turret face with a boring tool for the large hole. Tools on the square turret of the cross-slide take facing and chamfering cuts. Turning cuts are taken on this part in another machine after additional pieces have been welded to the inside.

A Chambersburg "Cecostamp" pneumatic drop-hammer is shown in Fig. 8 equipped with a double punch and die for the partial forming of a sheet-metal piece in the right-hand die impression and the complete forming of the piece in the left-hand impression. The drop-hammer punches are normally made of lead and the dies of zinc alloy; occasionally, zinc alloy is used for the punches also.

The heavy blows transmitted by this hammer, and several others of the same type, are absorbed by the special mounting and foundation provided, with the result that no shocks are transmitted to the adjacent boiler room and inspection cribs. The hammer is mounted on a heavy concrete block in which boiler-plate punchings were used for aggregate (to give it mass without bulk), and the concrete block floats on coil springs, equipped with single-action shock absorbers. The springs transmit the heavy static and impact loads to steel piles that have been driven 60 feet into the earth.

The use of Wales adjustable punches on a press brake for piercing a series of holes through the flanges of hat-shaped duralumin stringers is illustrated in Fig. 9. The punch-holders resemble C-clamps, and they are adjustably mounted along a rail in back of the long die member. When the ram of the press brake descends, it compresses the springs seen on the left-hand group of punch-

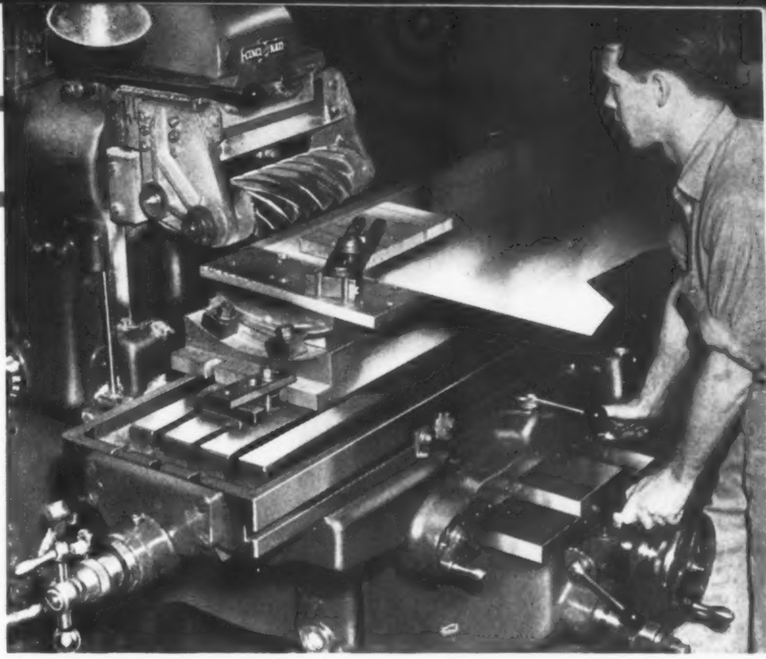


Fig. 4. (Above) Sheets of Aluminum Alloy are Scarfed to Feather Edges on This Machine by Means of a Long Helical Cutter

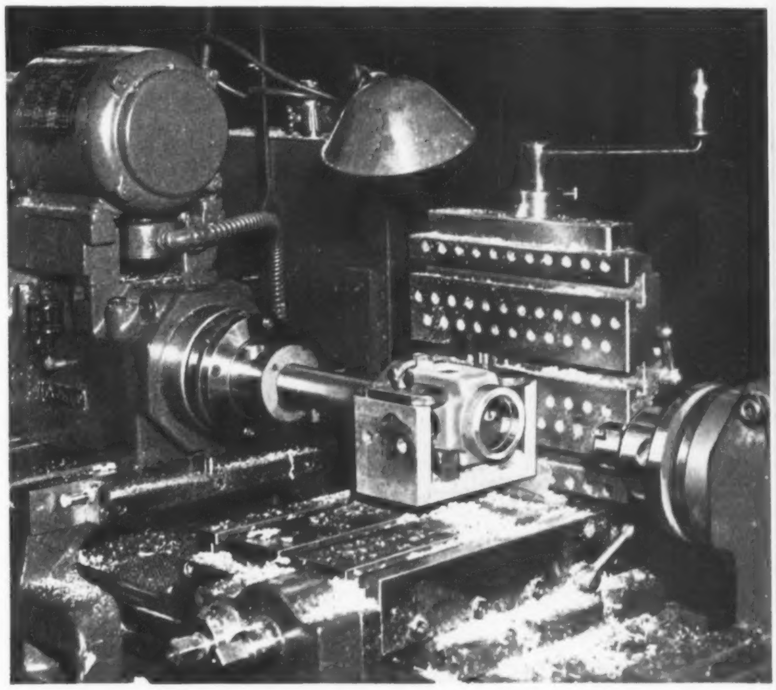


Fig. 5. (Above) Finishing Opposite Bores in a Casting on a Precision Boring Machine. Fig. 6. (Below) Offset Die for Crimping Structural Angles

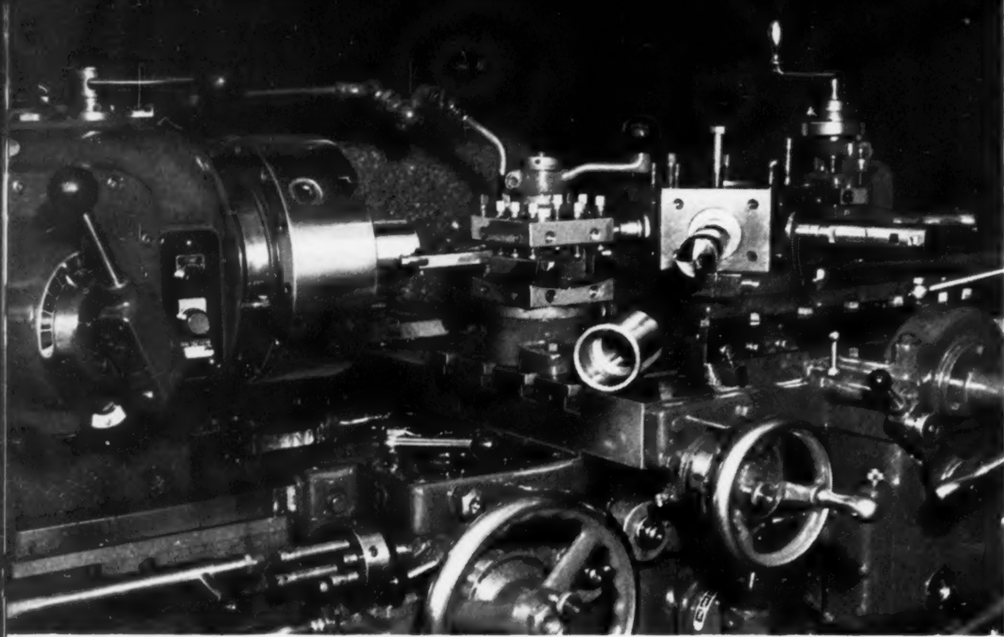
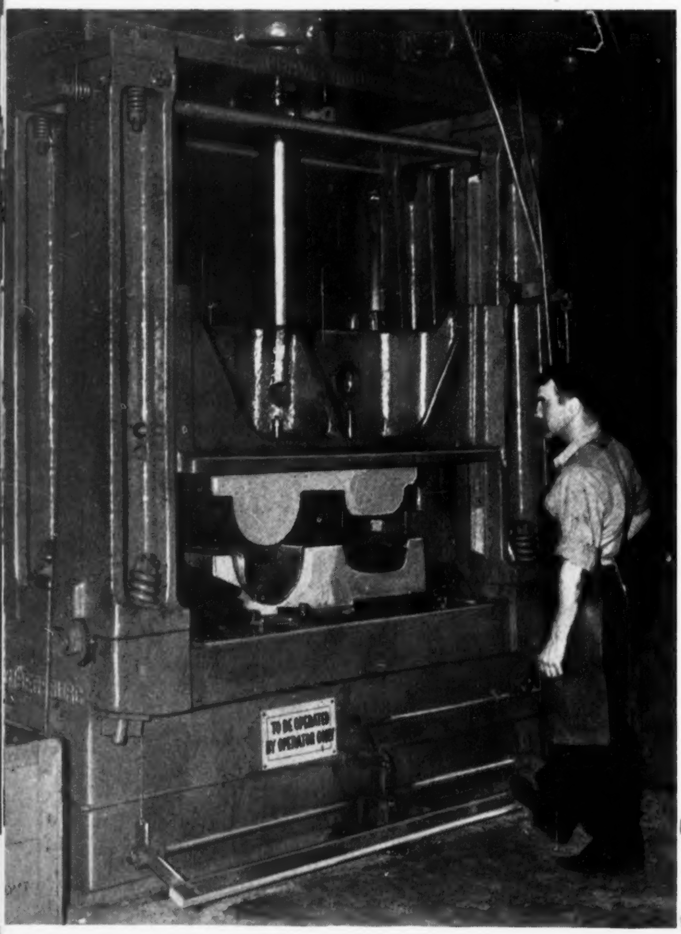


Fig. 7. (Left) Tooling for Producing Bearing Collars from Solid Bars of Chromium-molybdenum Steel

Fig. 8. (Below Center) Pneumatic Drop-hammer Employed for Forming Difficult Shapes by the Use of Zinc-alloy Dies



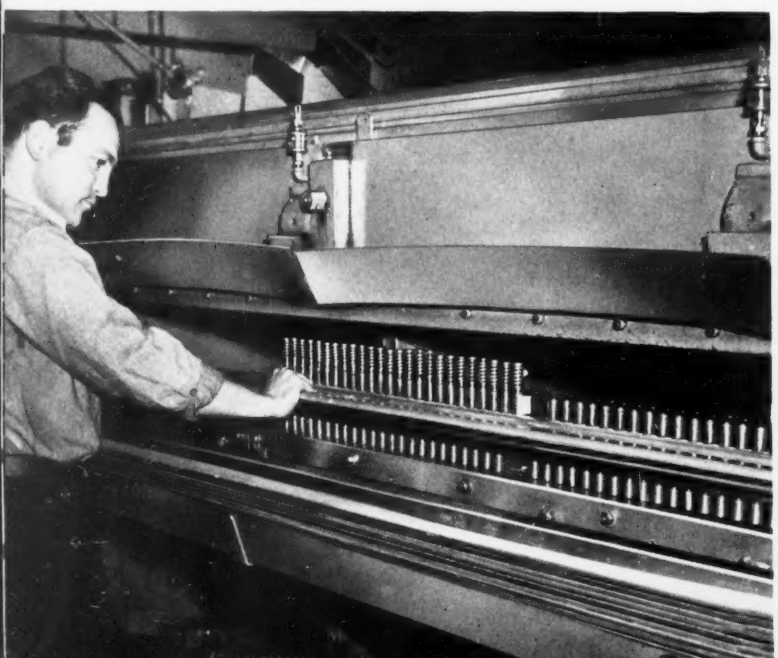
holders and forces the punches through the work. The springs pull the punches back up when the ram rises again. The punch-holders seen at the right without punches and springs were not in use at the time the photograph was taken. In the operation shown, twenty-five holes were being pierced simultaneously.

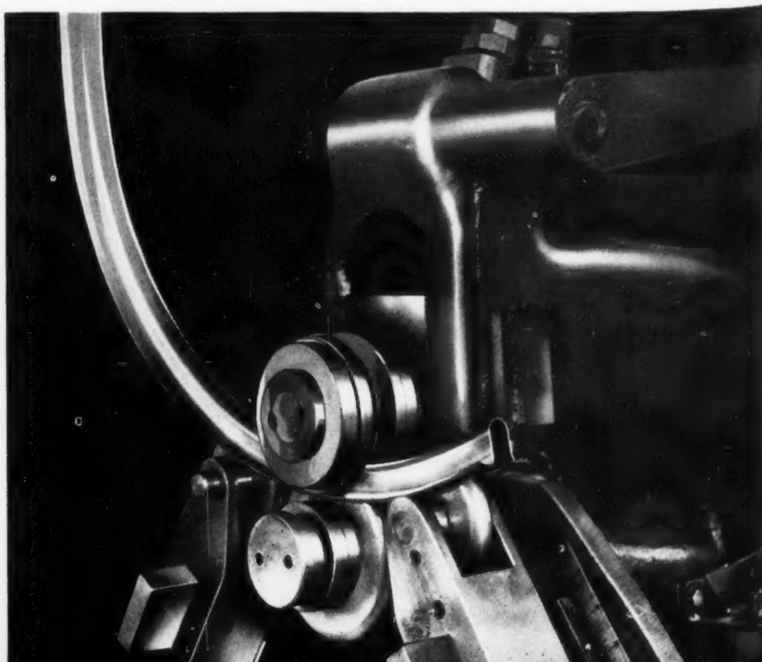
The hat-shaped stringers are rolled into the required curves by the Niagara rolling machine shown in Fig. 10, after having first been formed by pulling strip stock through the rolls of a draw-bench. Various curvatures are readily obtained by adjusting the lower rollers of the machine.

A second installment of this article will be published in a coming number of MACHINERY.

Fig. 9. (Below Left) Simultaneously Piercing Twenty-five Holes in Metal Shapes

Fig. 10. (Below Right) Rolling a Formed Duralumin Piece to the Required Radius





Engineering News Flashes

The World Over

Mammoth Machine for Making Woven Belting

In its plant at Easton, Pa., the Victor Balata and Textile Belting Co. has just installed a giant solid woven belt loom which is said to be capable of producing the widest woven belt in the world. This machine, which has an over-all width of 19 feet, a length of 18 feet, and a weight of approximately 26 tons, can produce a solid woven belt 7 feet wide. In belting of this character, the several thicknesses or plies are woven in a single operation.

Electric Eye Discovers Pin-Holes in Steel Strip

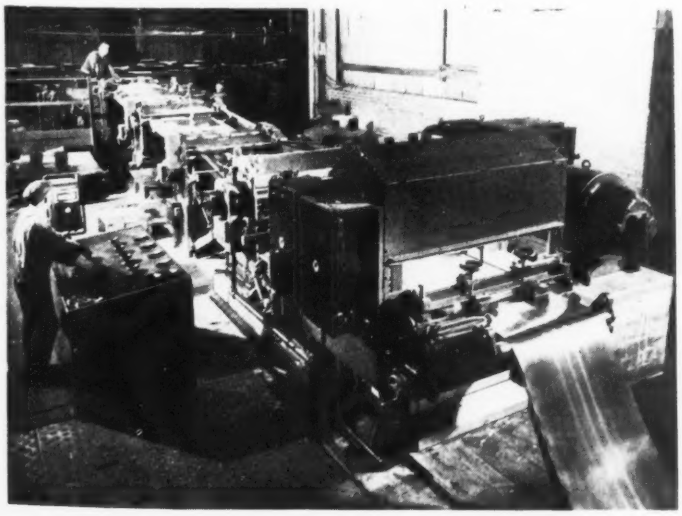
A Westinghouse photo-electric hole detector spots holes as small as 0.01 inch in diameter in sheet steel moving past the electric eye at the rate of 1000 feet a minute. The steel strip is trimmed on the edges to uniform width before entering the hole detector between guides and hold-down blocks which accurately guide the strip through the machine. As shown in the accompanying illustration, the strip is traveling from right to left, the photo-electric hole detector being in the foreground.

Two light sources are mounted in the enclosed cabinet overhead and the photo-tube housing is mounted below the moving sheet metal on a separate foundation to avoid vibration. The slightest hole in the steel strip will let light through, actuating the photo-tube and a marking device that scores the strip at the position of the hole. The two control cabinets mounted on the side of the equipment are for the detector unit and the marker. Immediately beyond the pin-hole detector is a machine that cuts the strips into exact lengths. After leaving the shear, the strip goes to a classifier which has a gate timed with the hole detector to open and discharge all defective sheets to a pit below.

New Rustproof Nail Having Greater Holding Power than Wood Screws

A rustproof nail of new design, developed for the boat-building industry, has revealed, in a series of tests, most unusual properties, indicating its value for a wide range of industries where corrosion is encountered. The nail is made from Monel metal. Its holding power is derived from the fact that a series of sharp annular ridges are rolled on the body of the nail during the manufacturing process. These ridges are set at such an angle that they do not disrupt the fibers of the wood when the nail is driven.

In tests made, it is claimed that this nail has shown greater holding power than a wood screw. The outstanding property of the nail, however, is that it is permanently rustproof and highly resistant to the action of salt water and other corrosive agents, including tannic acid. The new nail, which is manufactured by the Independent Nail and Packing Co., Bridgewater, Mass., has been given the trade name "Anchorfast."



A Sheet-steel Shearing Line Equipped with Photo-electric Hole Detector that Spots Holes as Small as 0.01 Inch in Diameter when the Sheet is Moving at a Speed of 1000 Feet per Minute

EDITORIAL COMMENT

Nations that have reached a high level of civilization abhor war. They realize that international questions can be settled satisfactorily only by honest, fair, and patient negotiations. They know that recourse to force never permanently settles any issue. They believe force and violence are resorted to only by nations who have not yet reached the level of truly civilized peoples.

To Remain a Free Nation We Must Prepare at Once

In this high conception, however, lies a great danger. So long as there are powerful nations who have not reached that level of civilization where force is viewed with abhorrence, so long even the most advanced nations must be prepared to defend their free institutions, their individual liberties, their ideals, and their heritage against the forces of brute strength. This, the democratic nations of the world, including our own, have neglected to do; and for that reason we now find ourselves poorly prepared to meet the challenge of a force that openly threatens to destroy the type of civilization that the world has slowly built, step by step, for a thousand years.

All Energies of the Nation Must Work toward One End

At last the free nations of the world are fully aware of the merciless forces that are planning to destroy them. Our own nation, now aroused, is preparing to meet the challenge. It is late, but it is not too late. Much as the people of the United States dislike to devote their energies to the production of means for destruction, instead of to those things that promote peace and happiness, they find themselves forced to do so as a measure of self-defense, in order that they may defend that civilization which the western world has accepted as the only mode of life worth while.

In this effort to prepare to defend our institutions, which are the institutions not only of our own nation but of civilization, all forces working for national integrity and well-being will work as one. Government, labor, and industry must cooperate toward the one end of placing this nation in a position where it can defend itself and its institutions against the powers which are trying to destroy all the worthwhile values of civilization. They must forget their differences, if differences there be, for the one common end—self-preservation. Much as the American people hate war, they must now unite in preparing for war.

Industry Holds the Key Position in the Defense Program

In modern warfare, the products of industry play an increasingly important part. The machines and implements of war are the products of engineering and of industry; hence, industry must be geared up to produce, as rapidly as possible, the means of defense that will enable the nations which stand for our type of civilization to protect themselves against the aggressors.

The mechanical industries hold a key position in this matter. They are the builders of the machines and equipment by which the aggressors must be stopped. For the production of aircraft, artillery, munitions, and all other ordnance and naval equipment, the mechanical industries must be mobilized. On them depends, to a marked degree, the outcome of the struggle between the two levels of civilization that are now engaged in battle.

Fortunately, in the United States, the high development of the mechanical industries makes it possible for us to get rapidly into the stride of mass production of any required equipment. By the coordination of the Army and Navy with all the factors of production, results that will astonish even ourselves can be accomplished. This was what was done during the last war, and it can be done again.

In this effort toward rapid acceleration in the production of armaments, MACHINERY will endeavor to do its part by devoting its efforts toward the publication of mechanical information that will prove helpful to those engaged in this work. The present number, devoted to aircraft manufacture, is the first step in this direction. From time to time, other phases of the Preparedness Program will be dealt with, all with the one end in view that the institutions in this country and in the world for which those who preceded us have sacrificed, fought, and suffered may be preserved.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Intermittent Gear Mechanism

By L. KASPER

A change required in a wire fabricating machine presented an interesting problem which was solved in an ingenious manner. On this machine, a uniformly rotating driving shaft transmitted its motion, in direct ratio, to the driven shaft through a pair of spur gears. Owing to a change in the manufactured product, it was required that the driven shaft be given alternately a half revolution and a period of rest corresponding to a full revolution of the driving shaft, and that the speed of the driven shaft and the center distance between the driving and the driven shafts remain unchanged. Figs. 1 and 2 show how these conditions were met without resorting to complicated declutching mechanisms.

Referring to Fig. 1, which shows three views of the assembly, gear *A* is carried on the driving shaft *B*. The driven shaft *H* carries the two gears *C* and *D*, the faces of which are half as wide as the face of gear *A*, so that both can mesh with gear *A* from the same center of rotation. Gear *D* is free on shaft *H* and meshes with gear *A*. Gear *C* is pinned to shaft *H* and has the teeth removed at two diametrically opposite points, the number of teeth removed being sufficient to prevent the rotation of gear *A* from being transmitted to *C* at these points.

Gear *E* rotates freely on stud *F* and has a definite number of teeth removed from the upper half of its face, so that during a portion of its rotation there is no contact with gear *C*. Gear *E* is idle during the greater portion of the cycle, its main function being to assist in the control of the timing of the rotation of driven shaft *H*. The diameter of gear *E* and the number of teeth removed from it are governed, of course, by the motion required. In this case, gears *A*, *C* and *D* each have 24 teeth.

The number of teeth removed from gear *C* must be sufficient to prevent contact with gear *A* at the required points. The removal of the teeth, however, does not affect the operation of the rotative cycle, the only requirement being that the number of teeth remaining in each section be sufficient to maintain contact between gears *A*, *C*, and *E* during part of the cycle. The number of teeth in the full gear *E* equals the number of teeth in the driv-

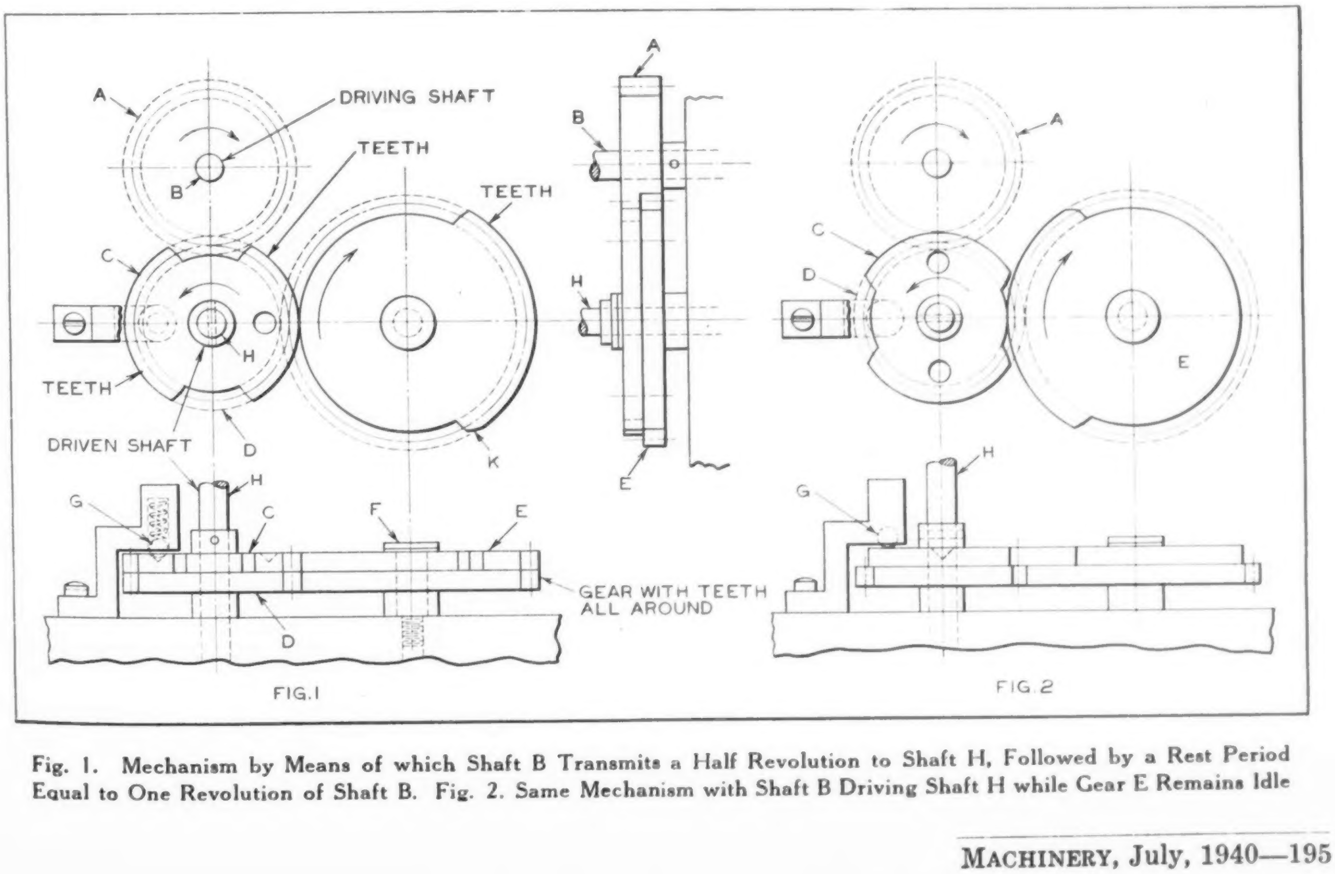


Fig. 1. Mechanism by Means of which Shaft B Transmits a Half Revolution to Shaft H, Followed by a Rest Period Equal to One Revolution of Shaft B. Fig. 2. Same Mechanism with Shaft B Driving Shaft H while Gear E Remains Idle

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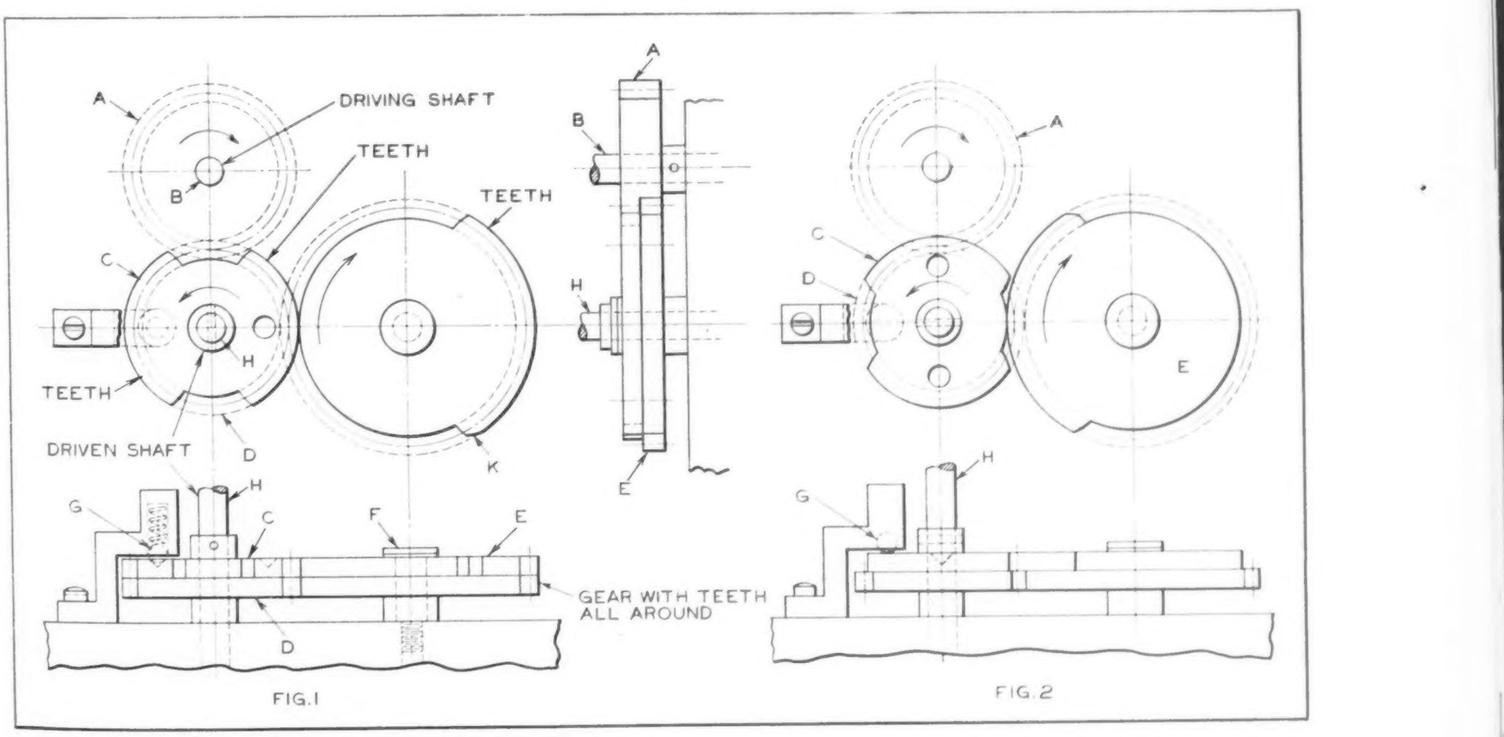

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ing gear A which will pass any given point during a complete cycle. As the complete cycle includes one rest period corresponding to a full revolution, and a rotating period corresponding to a half revolution of the driving gear A, the ratio between gears A and E will be 1 to 1.5; in other words, gear E in the lower or full-toothed side contains $24 \times 1.5 = 36$ teeth. The number of teeth removed from the upper half of gear E corresponds to one rest period, or 24 teeth.

Fig. 1 shows the assembly at the middle of the rest period. Gear A, rotating in the direction indicated by the arrow, transmits its motion in the reverse direction to gear D, rotating idly on shaft H. As there is no connection between gears A and C, the latter remains stationary. The rotation of gear D is transmitted to gear E, which, at this point of the cycle, forms no connection with gear C. The leading tooth in the upper half of gear E must be cut away somewhat, as shown at K, to insure free entry when contact is made with gear C.

When the first tooth of gear E engages gear C, the latter begins its rotation, transmitting it to the shaft H. It will be noted that, at this point, although gear E is responsible for the rotation of gear C, it is not acting as a driver; the teeth of gear E merely act as keys to lock gears C and D together so that they rotate in unison. As the teeth of gear C mesh with those of A, the drive is direct from A to C, gears D and E operating idly.

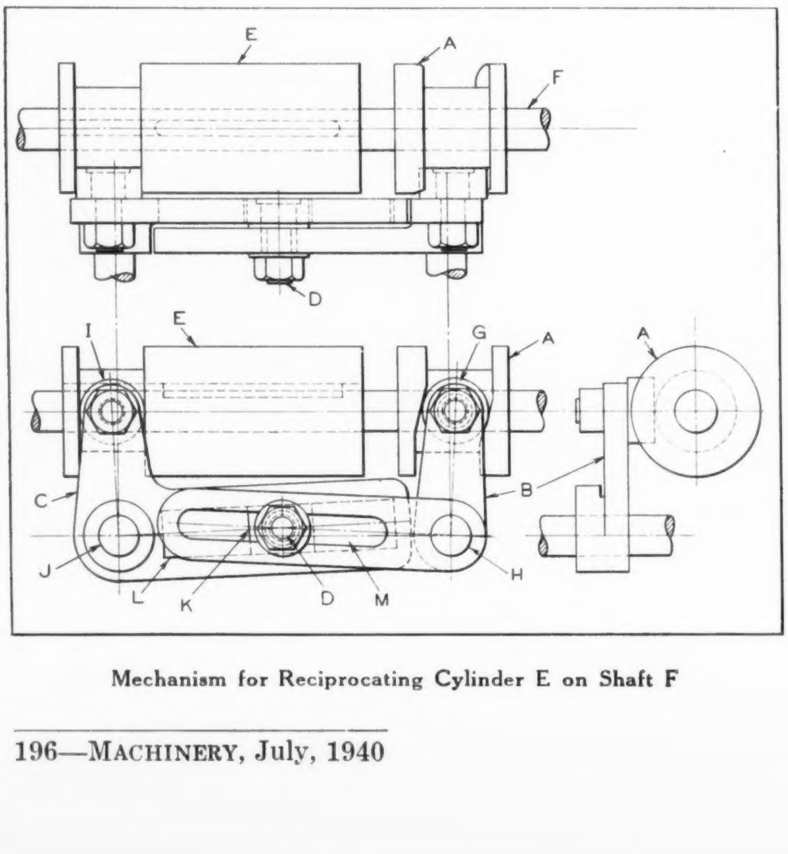
Fig. 2 shows the mechanism with half of the rotative portion of the cycle completed. At this point, gear E serves no useful function, its work being completed as soon as gear C comes under the driving action of gear A. Although the toothed portion of the upper half of gear E is passing through the toothless portion of gear C, this is merely incidental and would not occur if the driven shaft H were to receive a full revolution between rest periods. As the last tooth preceding the toothless portion of gear E passes out of contact with its mating tooth in gear C, the latter ceases rotation and the rest period begins, as at this time the toothless section of gear C is again in position to clear the teeth of gear A, as shown in Fig. 1. The spring ball-stop G was added, to prevent accidental rotation of shaft H.

Variable-Stroke Cam-Actuated Mechanism

By A. B. BASSOFF

The problem of providing a means for obtaining a variably controlled range of action from a single cam arises frequently in the design of various types of machines. The double lever mechanism, here illustrated, is simple, compact, and well adapted for solving problems of this kind. In its simplest form, it consists of a cam A and two levers B and C, pivoted on fixed centers and interlocked by a movable pivot stud D, which can be adjusted to vary the relative lengths of the active lever arms. One of the levers bears against the cam face while the other imparts the required reciprocating movement to the rotating cylinder E.

Cylinder E is free to slide axially on the main shaft F to which it is keyed. A cylinder cam A is fastened to shaft F. The roller follower G which fits the cam groove is mounted on the bellcrank lever B which swivels about the fulcrum stud H. Roller I, which fits the groove in cylinder E, is similarly mounted on bellcrank C that pivots on the fulcrum shaft J. The stud D carries a rectangular block K which slides in the wide slot L in bellcrank C. Stud D can be clamped in any desired position in slot M, machined in bellcrank B.

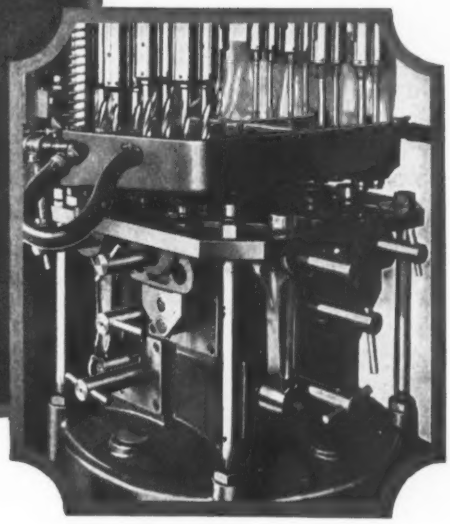


Mechanism for Reciprocating Cylinder E on Shaft F

When stud D is clamped midway between the two fulcrum points or studs J and H, the lever arms are of equal length, and consequently the axial movement imparted to the cylinder E is equal to the throw of the cam. To increase the movement of the cylinder, stud D is shifted toward fulcrum J. To decrease the movement of the cylinder, the stud is shifted toward fulcrum H. Not only can extremely fine variations of movement be obtained with this mechanism, but any desired range of movement can be obtained by properly proportioning the lengths of the slotted lever arms.

With this mechanism, complex movements are obtainable that might otherwise require elaborate mechanisms by making the fulcrum points adjustable, providing means for varying the position of the sliding block during the operating cycle, or substituting a cam of suitable curvature for the straight groove in cylinder E.

Design of Tools and Fixtures



Fixture Used on Boring Mill for Cutting Teeth in Large Gear Segments

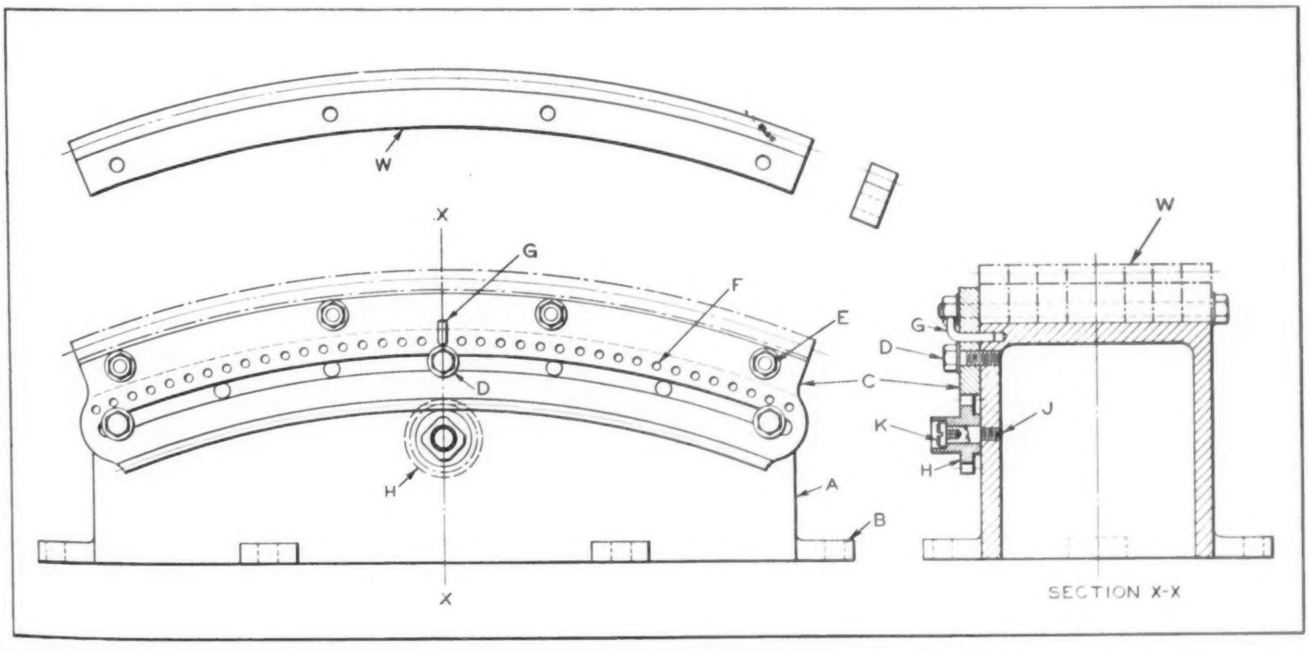
By JOSEPH WAITKUS, Wellsville, N. Y.

The problem of cutting the teeth in a gear ring 8 feet in diameter at a plant having limited gear-cutting equipment was solved by constructing the gear in segments. The finished segments were bolted to a machined ring to form the complete ring gear. The fixture illustrated was designed to hold eight gear segments like the one shown at *W*, and to provide the spacing or indexing movements required in cutting the teeth. The fixture was built for use on a horizontal boring mill, which was selected as the machine that was best adapted for the gear-cutting operation to be performed.

The fixture consists of a base *A* provided with lugs *B* for bolting it to the cross-feed table of the horizontal boring mill. The curved surface of the base is accurately machined to fit the inside radius of the ring segments. The templet *C* has a slot in it, into which bolts *D* are fitted, which guide and retain the templet in position on base *A*. There are four holes in templet *C* for bolts *E* which serve to fasten eight of the ring segments *W* to the templet, as indicated in the cross-sectional view.

A series of uniformly spaced holes *F* in templet *C* provides for obtaining the proper indexing of the work for cutting accurately spaced teeth. The spacing of the holes corresponds to the spacing of the gear teeth, a pin *G* being used as indicated for the indexing operations.

A gear *H*, in mesh with the teeth in the lower



Indexing Fixture Used in Cutting Teeth in Segments for Large Gear

edge of templet C, serves to actuate the latter member. The gear is fitted to a stud J and retained by screw K. A square shank on gear H fits the wrench employed to rotate the gear. After segments W are bolted to templet C, gear H is rotated until the templet is so located that the first indexing hole F is in line with the hole in base A. The first tooth space is then cut directly across the segments, the cross-feed being employed to carry the entire fixture and work under the cutter.

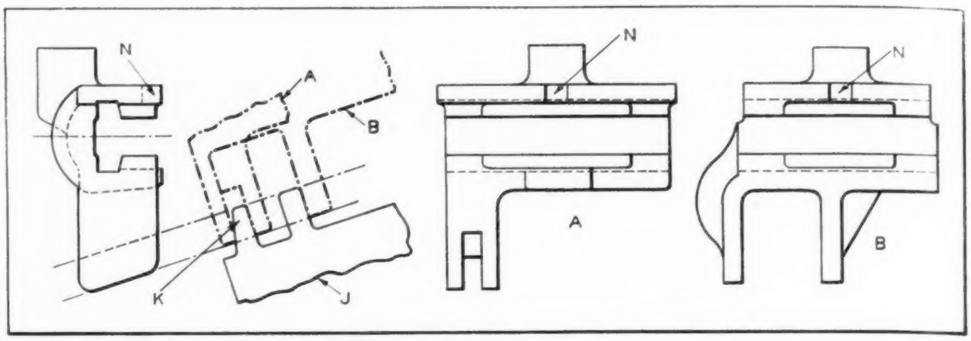


Fig. 1. Two Types of Shifter Yokes A and B Located in Milling Fixture by the Same Member J, as Indicated by the Dot-and-dash Lines

As soon as the tooth space is cut, the templet is moved so that the next indexing hole F coincides with the hole in base A, after which the tooth cutting operation is repeated. Before starting each cut, bolts D are tightened to lock the templet in position. Bolts D can be moved along to succeeding holes as the templet is advanced.

Quick-Acting Fixture for Notch-Milling

By ROY T. COYLE, Detroit, Mich.

The contract shop tool engineer is constantly faced with the task of adapting the shop's equipment for machining a great variety of parts as economically as possible. The two shifter yokes A and B, Fig. 1, are typical examples of the kind of work handled in one shop. The only available machine for milling the shifter notch N was a small hand mill. The production requirements were one hundred and fifty yokes of each type per hour, or a total of three hundred pieces per hour. The quick-acting, manually operated fixture shown in Fig. 2 enabled these requirements to be met without additional equipment or workmen.

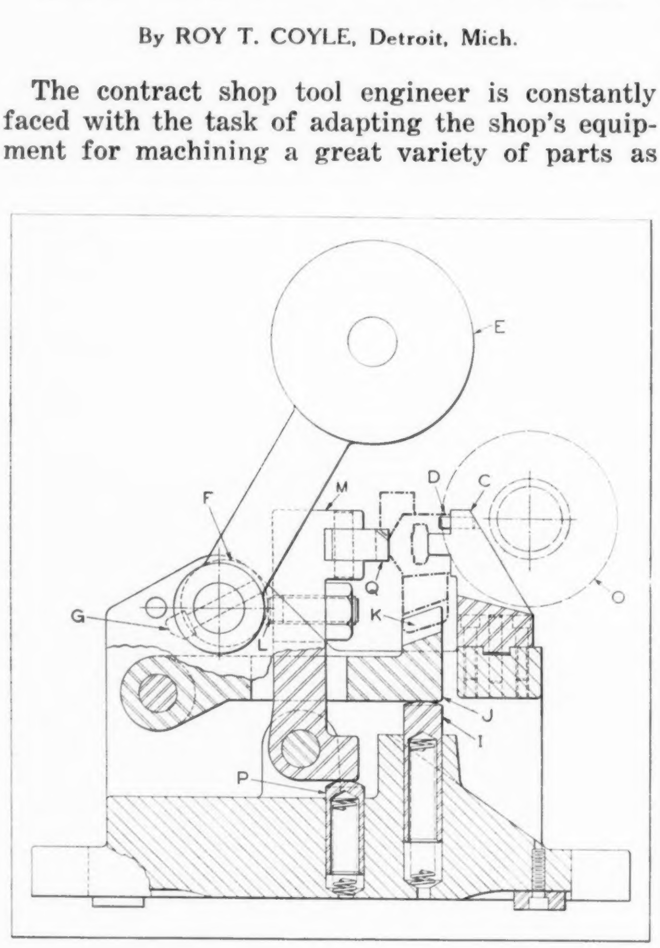


Fig. 2. Fixture Designed for Milling Slots N, Fig. 1, in Two Types of Shifter Yokes

The shifter yokes are milled one at a time. The operator feeds the yoke over the locating block C until it strikes the approximate locating pin D. He then moves the clamping lever E clockwise, rotating the cam F and cam pin G, and allowing spring plunger I to force locator J into the shifter yoke, as indicated at K, Figs. 1 and 2. This locates the shifter yoke accurately. Cam F, continuing to rotate, comes in contact with adjustable screw L in clamping bar M, thus clamping the shifter yoke securely while the selector notch N, Fig. 1, is machined by the milling cutter O, Fig. 2.

The operator merely reverses the motion of lever E to unload the fixture. Cam pin G pushes locator K down, while spring plunger P moves clamping bar M and clamp Q away from the shifter yoke, permitting the operator to unload the fixture.

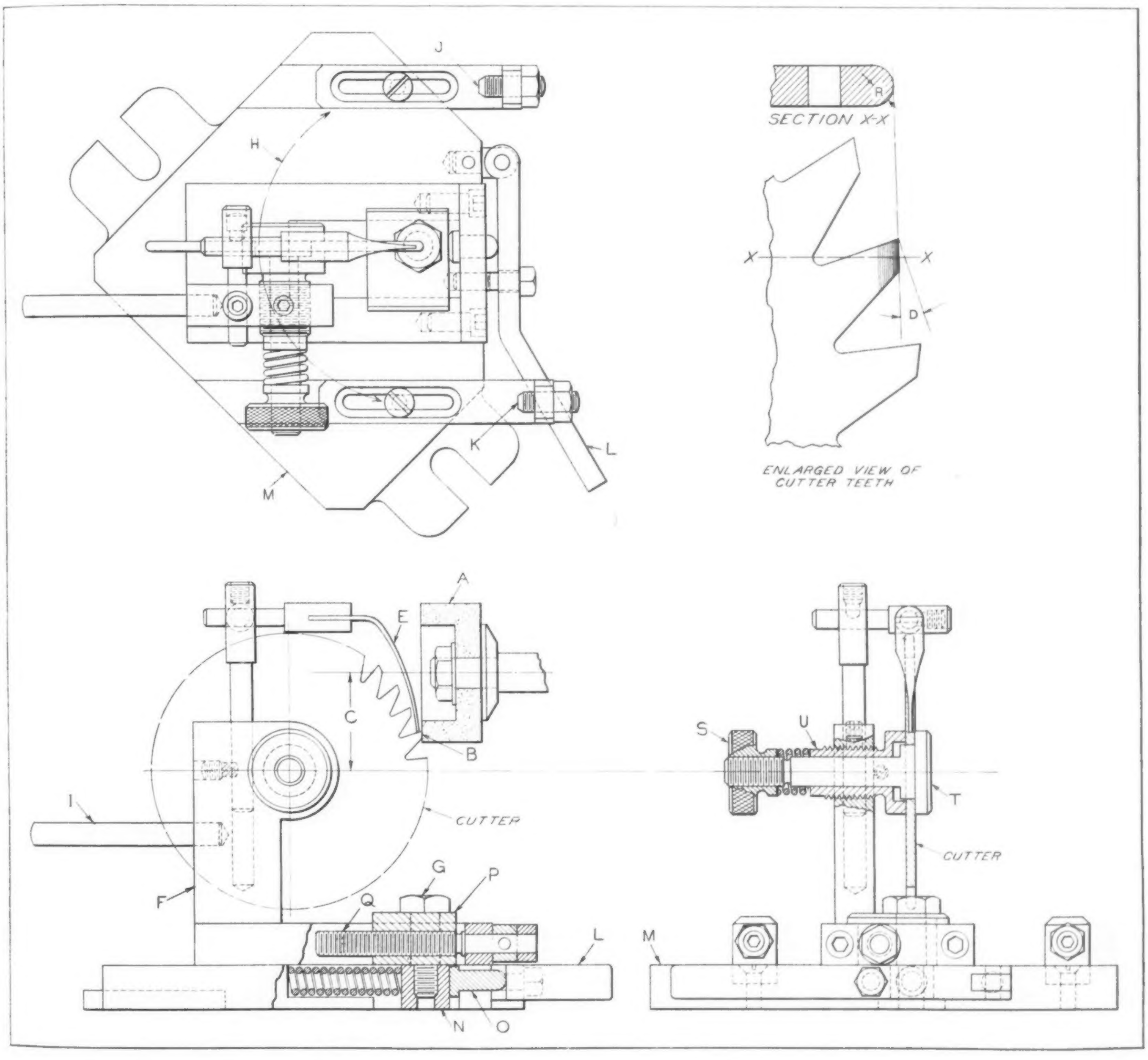
Radius-Forming Attachment for Cutter Grinder

By JOHN W. GERDEL, St. Louis, Mo.

In slotting aluminum pistons for an automobile engine of a certain type, it is necessary to use saws or cutters with teeth having radius-formed ends. The bottoms of the slots cut in the pistons are rounded, because there is a tendency for cracks to form in sharp corners. The attachment shown in the illustration for grinding the cutter teeth to the round form required for this work, as indicated by radius R in the enlarged section XX, was made because no suitable commercial attachment or grinding machine was available. During the last eighteen months, more than 500 cutters have been ground with this attachment, which is used on a tool and

cutter grinder. The attachment will handle cutters from 3 to 5 inches in diameter and of any thickness up to 3/4 inch.

In use, the attachment is bolted to the table of the cutter grinder, the spindle being set at an angle of 45 degrees. A small cup-wheel *A* is mounted on the grinder spindle and trued up. The grinding is done on the lower part of the cup-wheel, as indicated at *B*. The center of the cutter is set lower than the center of the grinder spindle a distance *C*, to provide sufficient clearance for the teeth, as shown by angle *D* in the enlarged view.



Cutter Grinding Attachment for Forming Teeth to Radius, as Indicated in the Enlarged View

With the cutter mounted as shown in the illustration and the tooth to be ground located against stop-gage *E*, cutter-holding housing *F* is swung back and forth by hand about the pivot screw *G*, as indicated by arrow *H*. Handle *I* is used for swinging the housing, the oscillating movement being limited by adjustable stops *J* and *K*. While stops *J* and *K* can be adjusted to permit a full 180-degree rotation of housing *F*, it is usually necessary to swing the housing through an angle of only 130 to 150 degrees. When the tooth has been ground in this way, lever *L* is pressed in to move the cutter away from the wheel and permit indexing the next tooth into position against stop *E*.

Referring to the design of the fixture, base *M* has a slot machined in it to receive block *N* and a spring for holding the block in position. Block *N* acts as a nut for pivot screw *G* and permits the cutter to be moved away from the grinding wheel when indexing the work. In moving the cutter away from the wheel by means of handle *L*, movement is imparted to the cutter through block *N* by shoulder pin *O* against which the handle presses. An adjustable block *P* for pivot screw *G* is fitted

in housing F. A screw Q provides adjustment of block P to suit the diameter of the cutter being ground. When the shoulder on pivot screw G is tightened against block N, there is just sufficient play to permit the housing F to be rotated.

A screw U is fitted in housing F to permit cutters of any width to be aligned with the center of pivot screw G. A set-screw is provided for locking screw U in position when it is properly adjusted. This adjustment is very important, as the center of radius R of the formed tooth must be in accurate alignment with the vertical axis of screw G. Cutter-holding mandrel T is provided with a shoulder to fit the bore of the cutters. This mandrel is flattened on one side of the small end which fits into screw U. A set-screw fitted into adjusting screw U presses against the flattened surface of mandrel T and keeps the mandrel from turning when the cutters are being indexed.

A spring between knurled nut S and the end of adjusting screw U serves to create a tension between the end of the adjusting screw and the head on mandrel T. Brass plugs are placed under all set-screws to prevent marring the surfaces against which they exert pressure.

In setting the attachment for grinding the cutter teeth to the required radius, a square is placed on the top of the pivot screw G, which has been carefully faced so that the edge of the square blade can be set in line with a small center mark in the top of the pivot screw. The edge of the cutter tooth is then advanced a distance past the edge of the blade equal to the radius to which the teeth should be ground.

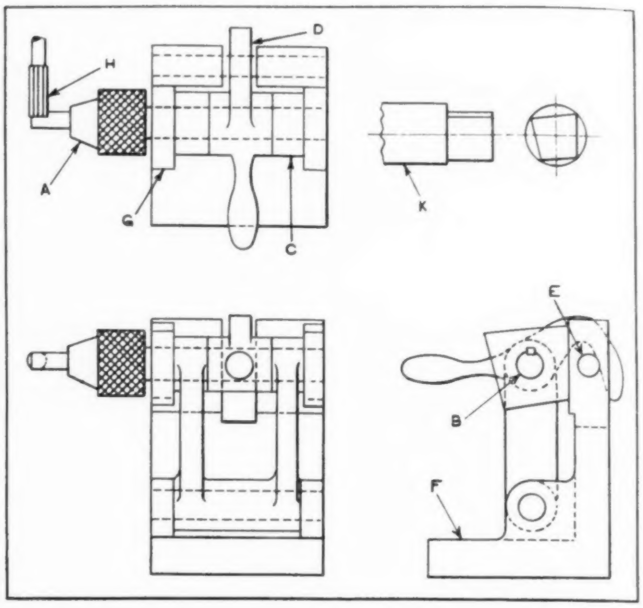
With the edge of the blade still on the center of the pivot screw, but turned 90 degrees from the previous position, the middle of the cutter is set approximately in line with the blade. The final adjustment is obtained by touching first one edge of the tooth with the wheel and then the other edge, adjusting screw U so that both sides will be ground evenly. Screw U is then locked in place and the cutter is ready for grinding the teeth to the required radius.

Milling Fixture for Cutting Irregular Shapes

By L. KASPER, Philadelphia, Pa.

The fixture shown in the accompanying illustration was designed for use in milling the four sides that form the irregular-shaped end of piece K. It was desired to mill a large number of pieces of the same shape as the one shown but of various sizes.

The chuck A that holds work K is carried on shaft B, which turns freely in the bearings of double lever C. Latch D is free to turn on shaft B and hooks around pin E carried in the angle casting F. Two blocks G of the same shape as that to be milled on the end of work K, but considerably larger in size, are keyed to shaft B.



Fixture for Use in Milling End of Piece K to Irregular Shape

The plan view of the fixture shows the end-mill H performing the first cut, the vertical feed of the milling machine being used. Blocks G are held rigidly in contact with the pads on angle casting F by latch D. At the completion of each cut, latch D is disengaged from pin E. Shaft B is then turned sufficiently to present adjoining surfaces of blocks G to the pads on the upper portion of angle F. In this manner, the shape milled on work K will be a duplicate of the shape of blocks G. The sizes are controlled by moving the work-table in the usual manner.

* * *

Is Industrial Unemployment Actually Technological?

According to a pamphlet published by N. W. Pickering, president of Farrel-Birmingham Co., Inc., and A. W. Rucker, economist, mechanization in industry has not been the cause of unemployment opportunities in our most important industrial areas. Instead, that loss is traceable to the heavy shrinkage in the number of going concerns between 1929 and 1937. The study embraces the total employment opportunity, payrolls, and average annual incomes per worker in eighteen industrial areas.

The authors conclude that the rational approach to the unemployment problem depends less upon a change in the Federal Administration than upon a change in public opinion as to the causes of unemployment. Since the political party in power generally reflects the majority public opinion, the unemployment problem is educational rather than political. To the degree that labor and management can cooperate to bring about a better understanding of the causes of unemployment, the solution of the problem will be more readily found.

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work

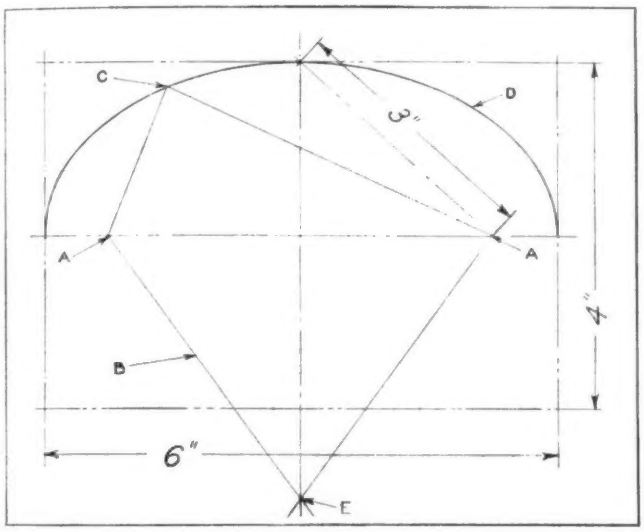


Diagram Showing a Simple Method of Drawing Ellipses Using Sewing Machine Needles

Using Sewing Machine Needles in Drawing Ellipses of Various Sizes

Two sewing machine needles are used in constructing an ellipse as shown in the accompanying diagram. The two needles are first located and pierced through the paper at points *A* to a depth that brings the holes in the needles even with the surface of the paper. The thread *B* is then run through the holes, as shown, with the pencil located at *C* in position for drawing the ellipse *D*. The ends of the thread are then crossed at *E* and held in place by pressing them against the table with the finger while drawing the ellipse. To draw an ellipse to a size other than *D*, the thread loop is simply lengthened or shortened. Shortened needle points, with shoulders, will pierce smaller holes, and add to the accuracy of the method.

Easton, Pa. E. G. SEASTROM

Relocation of Scrap Cutters Eliminates Trouble

The accompanying illustration shows two different arrangements of scrap cutters. The two cutters *A* originally used were placed directly opposite each other, as indicated in the top view. With this arrangement, trouble was often experienced because the scrap would not fall clear of the die, but would pile up on the punch, as shown at *D*, until one of the pieces jarred loose and fell across the face of the die, causing the punch and die to shear.

To overcome this trouble, cutters *A* were removed and cutters *B* placed at opposite corners of the punch, as shown in the top view. Cutting at corners, as shown, there is a tendency for the scrap to stick to the punch; in fact, it is automatically thrown clear on each down stroke. The parallel blocks *C* were also added. On the down stroke of the press, blocks *C* strike the face of the die about 0.01 inch ahead of the cutters, thus saving the cutter edges.

West Hartford, Conn. DONALD A. BAKER

* * *

Gear Production Indicates Increased Industrial Activity

The American Gear Manufacturers Association, 602 Shields Bldg., Wilkinsburg, Pa., states that gear sales during May were approximately 4 per cent above April, this year, and 43 per cent above May, 1939. The sales for the five months ending May 31, this year, were 33 per cent above the sales for the corresponding period last year.

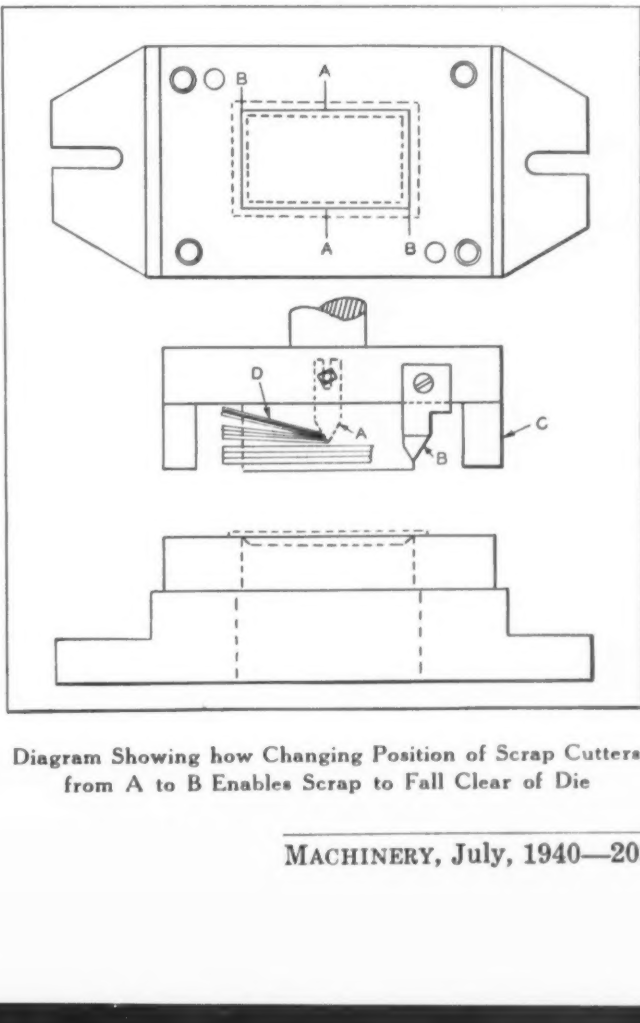


Diagram Showing how Changing Position of Scrap Cutters from A to B Enables Scrap to Fall Clear of Die

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

Materials for Hydraulic Press Cams

A. C.—The cams that we have used on a hydraulic press in the past have been made from ordinary cast iron, but this has not proved satisfactory from a wear standpoint. These cams are not machined, and it should, therefore, be possible to cast them without warpage. What material would be suitable for this service? The cams are about 3/8 inch thick on the wearing face and must be machinable, since they have drilled and threaded holes.

Answered by Editor, "Nickel Cast Iron News"
International Nickel Co., Inc., New York City

It is recommended that 1 1/2 pounds of "F" nickel shot and 3/4 pound of crushed ferro-chromium be added to each 100 pounds of metal from which the cams are poured. This will make a composition containing approximately 1.5 per cent nickel and 0.5 per cent chromium, which should have a hardness of from 200 to 250 Brinell on the cam surface.

It is possible to add 20 per cent more of the alloy elements to further increase the hardness, but this should only be done after it has been determined experimentally that, with this composition, the cams do not become too hard for subsequent machining operations.

When a Purchaser Refuses to Pay for Machinery that has been Delivered

M. B.—When and under what circumstances may a purchaser refuse to accept delivery of shipped machinery? Must the purchaser return it to the seller if he decides not to fulfill his contract and pay for the machinery?

Answered by Leo T. Parker, Attorney-at-Law
Cincinnati, Ohio

It is well established law that a purchaser is under no obligation to accept and pay for machinery if he can prove that before he signed the contract he informed the seller of the uses or purposes to which he intended to put the machinery, and that the delivered machine was incapable of producing satisfactory results. If the purchaser accepts delivery of the machine under the same circumstances, he is not obligated to pay for it. Doubtless a buyer in such a position must take reasonable care of the machine, but nothing more than that can be demanded of him. Accordingly, he is under no obligation to return the machinery to the seller, and after notice that it has not been, and will not be, accepted, the seller must assume the burden of taking such machinery from the purchaser.

For example, in Ver v. McDonald [258 N.W. 359], it was disclosed that a purchaser explained to a seller the exact quality of the equipment required and what he intended to do with it. The purchaser refused to accept the equipment and ordered the seller to remove it. The seller refused to do so and filed suit to recover the contract price, contending that the buyer could not rescind the contract after he had accepted delivery.

However, the Court held the buyer not liable for payment, and said: "The time within which the buyer may rescind must necessarily vary with the circumstances of the case ... The immediate consideration is whether the period elapsing, when not agreed to, has been long enough to result in prejudice to the seller."

* * *

Allied Powers are Not Buying Through Intermediaries

The Anglo-French Purchasing Board, 15 Broad St., New York, and 725 Fifteenth St., N.W., Washington, D. C., has issued the following statement:

"A number of complaints have been received by both the British Purchasing Commission and the French Purchasing Commission regarding the activities of unauthorized individuals in the Detroit area and other sections of the country, claiming to represent one or other of the purchasing commissions in the United States.

"We would call your attention to the fact that all representatives of the British Purchasing Commission and the French Purchasing Commission are supplied with credentials which they are willing and able to produce upon request. In the event that there is any doubt regarding the authenticity of the credentials presented by persons claiming to represent either of these purchasing commissions, manufacturers or others are urged to make inquiry immediately of the Anglo-French Purchasing Board, 15 Broad St., New York City.

"It should be noted that both the British Purchasing Commission and the French Purchasing Commission have constantly reiterated that it is their established policy to conduct negotiations only with principals and not with intermediaries."

Adjustable Idler Pulleys for Right-Angle Belt Drives

By MARTIN H. BALL

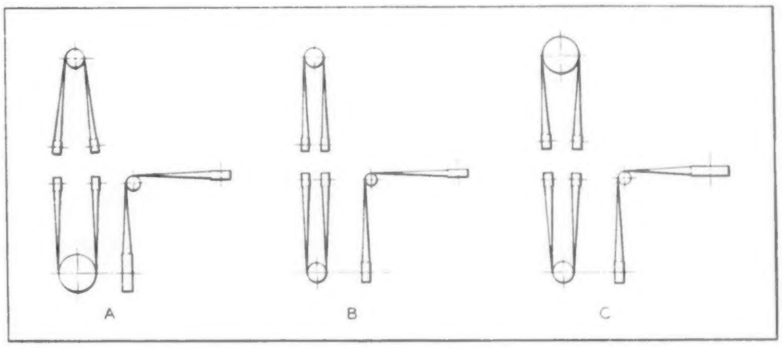


Fig. 1. Diagrams Showing Right-angle Belt Drives Requiring Different Adjustments of Idler Pulleys Shown in Fig. 2

THE adjustable idler pulleys shown in Fig. 2 are designed to be used in conjunction with driving and driven pulleys of various sizes employed in right-angle belt drives. The idler pulleys are located on a plain shaft *H* which is mounted in a fixed position. Drives of this kind are used where a straight-line or open belt cannot be employed between the driving and driven pulleys and where the use of the mule-stand principle of idlers is required to transmit power around corners, as indicated in Fig. 1.

The arrangement shown in Fig. 2 provides not only the angular adjustment required for alignment of the idler pulleys to accommodate driving and driven pulleys of various sizes, but also a means of adjustment for leading and holding the belt to its central position on the pulleys when one edge has been elongated or stretched. Difficulty in keeping the belt properly centered on the pulleys because of an elongated edge is most common with short shaft-center drives, but a quarter-turn drive exerts an uneven tension on the belt to a greater extent than straight drives. The best belting material obtainable should be used for drives of this kind, in order to reduce uneven stretching effect to a minimum.

The belt-drive flanges shown at *A*, Fig. 2, are fixed, or stationary. Tests have shown that a fixed belt guide that is independent of the pulley is more efficient than flanges on the pulley itself in guiding and keeping the belt centered on the pulley. The arrangement shown in Fig. 2 allows adjustment of both the idler pulleys *B* and *C* to any desired position on the idler shaft. The idler pulleys, provided with angle bushings *D* and *E*, can be adjusted to any angle within their range by rotating the bushings on the shaft *H*. The set-screws *F* serve to lock the bushings *D* and *E* and the inner flanges to shaft *H*.

The angular bores through the bushings are central with their respective outer bearing surfaces at the vertical center lines of their pulleys. This common center remains true with the shaft, regardless of the angle to which the bushings are set. The idler pulleys are provided with a heavy crown and are made about 3/4 inch wider than the belt. The outside flanges are secured to bushings *D* and *E* by set-screws *G*.

The idler pulleys revolve freely on the bushings *D* and *E* between the stationary flanges *A*. The relative arrangements of pulleys for angular belt drives are shown in Fig. 1. The arrangement used when the driving pulley is larger than the driven one is shown at *A*, while the arrangement for driving and driven pulleys of the same size is indicated at *B*. At *C* is shown the same type of drive with a driven pulley that is considerably larger than the driving pulley. The upper view of bushing *E*, Fig. 2, shows a tapped hole for attaching a pipe or oil-cup to the outer end of the bushing at *J*. A hole drilled parallel with the bore of the bushing leads to the groove *K* that encircles the bearing surface. From this groove the oil is carried in both directions over the shaft to the pulley bore and hubs.

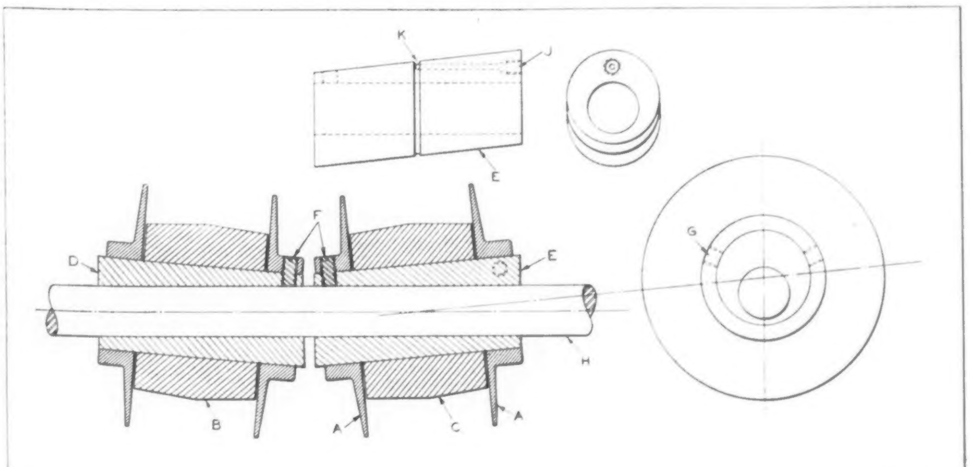
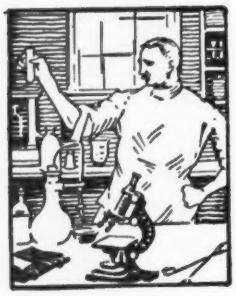


Fig. 2. Adjustable Idler Pulleys for Use in Right-angle Belt Drives

MATERIALS OF INDUSTRY



THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Value of Nickel in Heat-Treating Equipment

Because it tends to increase strength at high temperatures and to form a tenacious oxidation-resistant scale, nickel as an alloying material is useful wherever annealing, heat-treating, nitriding or carburizing is done. Thus, light-weight fabricated boxes of Iconel sheet are replacing heavier cast carburizing boxes. The application of radiant tubes of high-nickel alloys has increased during the past year. For cast pots to hold molten lead used in the heat-treatment of steels, an alloy of 60 per cent nickel has been found to give some 20,000 hours of service. 201

Liberty Rubber—A Synthetic Rubber Developed by B. F. Goodrich Co.

The B. F. Goodrich Co., Akron, Ohio, has announced the development of a substitute for natural rubber. This synthetic rubber is known by the trade name "Liberty," and is produced from a substance called "Ameripol," developed by the Goodrich company during a long period of experimental work.

Fourteen years ago, this company took up the challenge to produce synthetic rubber. Its research laboratories finally succeeded in producing, solely from American raw materials, a synthetic product that, in many of its important properties, is equal or superior to natural rubber. This material, according to the company, does not infringe on any existing patents.

What are the ultimate raw materials from which this synthetic product is made? The basic one is petroleum. Other ingredients are prepared from natural gas and air. Soap produced from American agricultural sources is also used in the process. From these materials is produced an emulsion of synthetic rubber that is similar to the latex obtained from rubber-producing trees. The process of producing sheet rubber with these materials is similar to that used for natural rubber.

Based upon the results of the laboratory accomplishments, the company built a small experimental plant which has been in operation for a year and a half. Last summer, a semi-commercial plant, which is now producing Ameripol, was built; and at the present time, the company is constructing a regular manufacturing plant to be ready this fall. This unit will have a daily capacity of several tons. Additional units can be constructed at any time to produce any required amount of this substance.

Rubber tires for automobiles are now made from this synthetic product. For many purposes and products, synthetic rubber, even though more costly, is far better than natural rubber. Among such products are gasoline hose, pressure hose, and parts of the expander tube brake for airplanes. Unlike natural rubber, the synthetic product resists swelling when immersed in gasoline or mineral or vegetable oils, and does not lose tensile strength.

Ameripol today costs much more than natural rubber; for this reason, the new automobile tires will be higher in price. However, with increase in production, economies may be expected that will reduce the price. 202

Electrical Contacts Made from a Powdered Metal Composition

Formed out of a powdered metal composition in the shape of rivets or buttons which are soldered on base metal for spot-welding, electrical contacts possessing high conductivity and constant resistance are being marketed by the Gibson Electric Co., Pittsburgh, Pa., under the trade name of "Gibsiloy."

The range in compositions of these contact alloys includes eight grades of nickel silver, silver-nickel-tungsten, silver-nickel-molybdenum, and silver-nickel-cadmium. Most of these powdered metal compositions are also produced in rod, strip, or wire form, and are sufficiently ductile to be headed into rivets, bent, or coined to any shape required. The hardness ranges from that of pure silver to 200 Brinell for some grades of silver-nickel-tungsten. 203

To obtain additional information about materials described on this page, see lower part of page 212.

New High-Impact Plastic with Unusually Smooth Finish

A new high-impact phenolic molded material known as Durez 1900 Black, which is easily preformed and has an unusually smooth finish, has been developed by Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y. The size and shape of the particles give this material excellent preforming properties and permit a ready flow through hoppers and automatic feeding devices. For this reason, it has been found suitable for the production of parts requiring a high-impact material that had previously been considered impractical for molding......................204

Silver-Bearing Stainless Steels Available in the Form of Castings

Two forms of silver-bearing stainless steel have been made available by the Lebanon Steel Foundry, Lebanon, Pa., in the form of castings. Both are of the familiar 18-8 composition, but in one molybdenum is added. The silver, which is present only in the amounts of about 0.1 to 0.3 per cent, provides resistance to pit corrosion, particularly in salt water; improved machinability; diminished work-hardening; increased thermal conductivity; and ability to take a high polish.

Tests conducted on the steel when forged showed a yield strength of 53,000 pounds per square inch; an ultimate strength of 92,500 pounds per square inch; a reduction in area of 72.7 per cent; and an elongation in 2 inches of 55 per cent. It is expected that the improved characteristics of these two stainless steels will meet the requirements of many applications where the former stainless steels have not proved fully satisfactory...............205

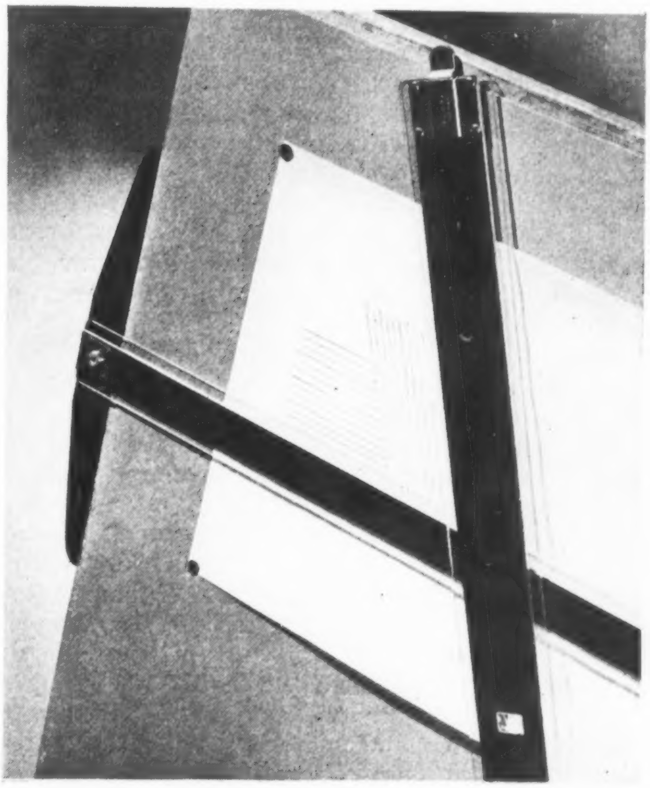
Chromium-Molybdenum Alloy Steel for Superheater and Steam-Valve Parts

Alloy steel containing 5 per cent chromium and 0.50 per cent molybdenum is used for the superheater tubes at the Detroit Edison Delray Power Station. These tubes operate at temperatures above 925 degrees F. and at gage pressures ranging from 865 to 925 pounds per square inch. Under certain unusual conditions, pressures slightly over 1000 pounds per square inch have been attained. The use of steel with high creep strength and good resistance to oxidation at high temperatures is essential.

The valves for the high-temperature steam lines are also made of alloy steel, in this case a nickel-chromium-molybdenum alloy steel being used. The valve stems are made from stainless steel, and the valve disks, as well as many of the valve seats, are hard-faced with a chromium-cobalt-tungsten alloy. 206

Coating Metal by Adhesion and Surface Fusion

A number of metals, including zinc, cadmium, tin, bismuth, lead, and their alloys, can now be easily and effectively used to coat ferrous and non-ferrous metals by a process that requires only two operations. The material used is known as "Colaweld Mormetal," and is manufactured by the Colonial Alloys Co., of Philadelphia, Pa. It is applied by a spray, brush, or as a powder, and then heated by a torch, oven, or other means. The result is an effective adhesion and fusion bond between the coating and the base metal, which provides high resistance to corrosion, abrasion, and erosion. The thickness of the metal deposit is easily regulated. It is claimed that high-speed production is possible and that experienced labor is unnecessary. This process is of special interest in the fields of marine construction, transportation, building equipment, and general maintenance. 207



T-squares and Straightedges Made from Bakelite Laminated Material (Formica) and Provided with Transparent Cellulose Acetate Edges are now being Made by the Engineering Sales Co., Sheboygan, Wis. The Material is Light in Weight, and will not Warp or Split. The Edges Remain Permanently True. The Instruments are Easily Cleaned with a Damp Cloth

To obtain additional information about materials described on this page, see lower part of page 212.

Machining Chrome-Nickel-Molybdenum Steels of High Tensile Strength

Recommendations Made by the Morse Twist Drill & Machine Co. for the Machining of Alloy Steels Having a Tensile Strength from 150,000 to 180,000 Pounds per Square Inch, as Applied in Many of the Aviation Plants throughout the Country

By A. J. SNYDER, Research Engineer
Morse Twist Drill & Machine Co., New Bedford, Mass.

THE machining of the high tensile-strength alloy steels has always presented certain difficulties until, through experimentation and research, the proper kind of cutting tool material, the right design of tool, and the correct cutting lubricant have been found. These difficulties become accentuated when alloy steels of such high tensile strength as the chrome-nickel-molybdenum steels now available are to be machined. Steels of this class have a tensile strength of from 150,000 to 180,000 pounds per square inch.

In milling these steels, cutters made from forgings of super high-speed steel are recommended. For roughing cuts, the standard form of tooth and number of teeth employed in the cutters made by the Morse company are recommended, with a radius on the corners of the cutting teeth. For finishing cuts, cutters with finer tooth spacing are desirable. A peripheral cutting speed of 30 feet per minute is considered good practice, and sulphur-base oil, used liberally, is the most preferable cutting lubricant.

For tapping through holes in these high tensile-strength alloy steels, a high-speed, ground-thread, spiral-pointed tap can be used to the best advantage. Incidentally, this style of tap is a very good one to use for practically all classes of tapping, except for blind holes in which the thread must be cut close to the bottom of the hole. The design of the spiral-pointed tap makes it possible to obtain a shearing cut, and the chips are forced out ahead of the tap. This design, therefore, provides a very free-cutting tap.

For blind-hole tapping, a four- to six-fluted tap made from high-speed steel, with ground threads, is recommended. For pipe tapping, a taper pipe tap with ground threads is recommended. The tap should be preceded, wherever possible, by a pipe reamer. The tapping speed for chrome-nickel-molybdenum steel should not exceed 15 to 20 peripheral feet per minute; the tap drill size should be so selected as to allow from 75 to 80 per cent of a full thread. A sulphur-base oil or a mixture of a sulphur-base oil and white lead will prove satisfactory as a tapping lubricant.

For chucking reaming this kind of steel, a super-high-speed steel, solid chucking reamer with right-hand spiral and right-hand cut is recommended. The Morse company gives these reamers, after finishing, a special heat-treatment which greatly increases the life. The speed for this type of reaming should not exceed 20 peripheral feet per minute; a sulphur-base oil should be used as the cutting lubricant.

For drilling holes 1/2 inch in diameter and smaller, heavy-duty high-speed steel drills are recommended. For holes larger than 1/2 inch in diameter, high-speed cobalt-steel drills should be used. The Morse company has developed special styles of drills for the drilling of these high-strength alloy steels.

* * *

Rise in the Exports of Industrial Machinery

The United States exports of industrial machinery aggregated over $40,000,000 in April—65 per cent more than during the same month in 1939—according to Lewis M. Lind, chief of the Machinery Division of the Bureau of Foreign and Domestic Commerce. The shipments during April were the second highest on record and were only surpassed in December, 1920, when the shipments amounted to about 2 1/2 per cent more.

The exports of power-driven metal-working machinery reached the record figure of $21,280,000 in April, an increase of 140 per cent over the shipments of the same month in 1939, when the shipments amounted to $8,855,000. The April exports of metal-working equipment, exclusive of power-driven machines, were 62 per cent greater in April, 1940, than in the corresponding month last year.

* * *

The first typewriting machine, according to *The Inventor*, was designed and built by Thurber in 1843.

NEW TRADE  LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Check on Form at Bottom of Page 211 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the July Number of MACHINERY

Electric Heating Units

GENERAL ELECTRIC CO., Schenectady, N. Y. Circular GEA-104B, on General Electric cartridge type heating units; 214D, on immersion heaters for water and oil; 1157C, on strip heaters; 1265D, on thermostats for use with Midget heating units; 2592A, on unit heaters of forced and natural convection types; 2618A, on G-E fin Calrod heating units for forced-convection air heating. 1

Heat-Treating Equipment

LEEDS & NORTHRUP CO., 4921 Stenton Ave., Philadelphia, Pa. Catalogue N-33, describing the complete line of Micromax and other L & N pyrometers. Booklet T, containing data on heat-treating furnaces that apply the Vapocarb Hump method to hardening, the Hump method to drawing, and the Homo method to tempering, nitriding, and carburizing. 2

Bending Presses

CLEVELAND CRANE & ENGINEERING CO., STEELWELD MACHINERY DIVISION, Wickliffe, Ohio. Catalogue 2002-34, illustrating and describing the complete line of "Steelweld" bending presses. Valuable engineering information and data on dies, typical bends made on these machines, multiple punching, etc., are included. 3

Metal Sawing and Shaping Machines

CONTINENTAL MACHINES, INC., 1312 S. Washington Ave., Minneapolis, Minn. Publication entitled "Here's What Others are Doing with Do-All," describing a wide variety of jobs performed on this type of equipment. Also folder describing details of the Doall contour shaping machine. 4

Machining, Welding, and Finishing Aluminum

ALUMINUM CO. OF AMERICA, Pittsburgh, Pa. Booklets containing helpful information on the machining, riveting, and welding of aluminum. Booklet containing data on the finishing of aluminum by grinding, polishing, electroplating, etc. 5

Stainless Steel

REPUBLIC STEEL CORPORATION, Cleveland, Ohio. Bulletin No. 361, on stainless and heat-resisting steels; No. 362, on 18-8 types of stainless steel; No. 363 on Types AA, AA-FM, S-1, and FC stainless steels; and No. 364 on Types HCN, NC-3, and HC corrosion- and heat-resisting steels. 6

Die-Castings, Lubricators, and Air Tools

MADISON-KIPP CORPORATION, 203 Waubesa St., Madison, Wis. Catalogue covering die-castings and die-casting equipment, complete lubrication equipment for all types of machinery, and air tools for grinding, chipping, and filing. 7

Twist Drills

WHITMAN & BARNES, 2108 W. Fort St., Detroit, Mich. Circular on high-speed and carbon steel drills; also covering drills especially designed for different materials, and showing recommended drill points for different classes of work. 8

Automatic Valve Controls

PHILADELPHIA GEAR WORKS, Erie Ave. and G St., Philadelphia, Pa. 66-page catalogue on Limitorque automatic valve controls for operating valves from 3 to 96 inches in diameter, as well as for many other remote control purposes. 9

Beryllium-Copper Alloys

BERYLLIUM CORPORATION OF PENNSYLVANIA, Reading, Pa. Engineering Data Sheet containing information on the composition, heat-treatment, physical properties, and uses of the beryllium-copper alloy known as "Berylco No. 25." 10

Grinders, Sanders, and Attachments

JEFFERSON MACHINE TOOL CO., Fourth, Cutter, and Sweeney Sts., Cincinnati, Ohio. Circular on swing-frame grinding and polishing machines, endless belt sanders, and tailstock and toolpost turrets. 11

Copper, Brass and Bronze Products

REVERE COPPER & BRASS, INC., 230 Park Ave., New York City. Book entitled "Revere Weights and Data," containing complete tables of weights and other important data on copper, bronze, and brass products. 12

Equipment for Applying Buffing Compounds

PACKER MACHINE CO., Meriden, Conn. Circular 11, on the Packer-Matic electric automatic composition applicator for automatically applying buffing compounds to buffing wheels. 13

Electric Equipment

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Booklet 15-800, describing SM heavy-duty, direct-current, magnetic contactors. Leaflet F-8533, on fractional-horsepower motors. 14

Packing

BELMONT PACKING & RUBBER CO., 3636 Sepviva St., Philadelphia, Pa. Catalogue covering the company's line of packing, listing forms available, important features, materials, applications, and approximate weight. 15

Microscopes for Industrial Purposes

SPENCER LENS CO., Buffalo, N. Y. Catalogue describing stereoscopic microscopes suitable for laboratories, metallurgical work, and general industrial purposes. 16

Ball Bearings

FAFNIR BEARING Co., New Britain, Conn. Catalogue covering Fafnir super-precision ball bearings and their applications to grinding, drilling, polishing, boring, and other machining equipment. 17

Lathes

R. K. LEBLOND MACHINE TOOL Co., Cincinnati, Ohio. Forty-eight page catalogue entitled "March of the Masters," illustrating and describing the company's line of Regal lathes. 18

High-Production Turret Lathes

GISHOLT MACHINE Co., 1209 E. Washington Ave., Madison, Wis. Performance Data Sheets 38 to 45 inclusive, containing actual performance data obtained from users of Gisholt turret lathes. 19

Nickel-Alloy Steels

INTERNATIONAL NICKEL Co., INC., 67 Wall St., New York City. Publication entitled "The Working of S A E Nickel-Alloy Steels," compiled from the practice of thirty-four leading fabricators. 20

Lighting Equipment

WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. Booklet F-8500, describing a twin-lamp fluorescent luminaire for general or supplementary lighting in low-bay industrial areas without glare. 21

Steel

CRUCIBLE STEEL CO. OF AMERICA, 405 Lexington Ave., New York City. Publication entitled "Crucible News," giving a complete description of steel making at the company's Midland Works, Midland, Pa. 22

Wires for Gear Measurements

VAN KEUREN Co., 176 Waltham St., Watertown, Mass. Circular G33, giving simplified tables to facilitate measurements over wires for external and internal spur gears with various pressure angles. 23

Ball and Roller Bearings

AHLBERG BEARING Co., 3052 W. 47th St., Chicago, Ill. Catalogue containing data on ball bearings, tapered roller bearings, straight roller bearings, thrust bearings, and ball-bearing pillow blocks. 24

Vibration Isolation

FELTERS Co., INC., 210 South St., Boston, Mass. Catalogue descriptive of the application of "Unisorb," a base or mounting for industrial machinery designed to reduce vibration and noise. 25

Hardness and Sheet-Metal Testers

PITTSBURGH INSTRUMENT & MACHINE Co., 1026 Reedsdale St., Pittsburgh, Pa. Catalogue on Brinell hardness testers and metal-sheet testers. 26

Removal of Scale and Rust

OAKITE PRODUCTS, INC., 26 Thames St., New York City. Booklet describing a recently developed material, Oakite Compound No. 32, for removing rust and scale. 27

Grinding Machines

LANDIS TOOL Co., Waynesboro, Pa. Catalogue entitled "Landis Grinders for the Airplane Industry," illustrating and describing numerous aircraft applications. 28

Steel

JOSEPH T. RYERSON & SON, INC., 16th and Rockwell Sts., Chicago, Ill. 1940-41 catalogue of Ryerson steels, certified quality, available in stock for immediate shipment. 29

Control Instruments

BRISTOL Co., Waterbury, Conn. Bulletin 548, on control instruments for industrial furnaces, kilns, and ovens. Bulletins 543 and 555, on recording voltmeters and ammeters. 30

Speed Measuring Instruments

HERMAN H. STICHT Co., INC., 27 Park Place, New York City. Folder 700, covering the company's line of speed measuring instruments for all speeds up to 100,000 R.P.M. 31

Welding, Cutting, and Soldering Equipment

IMPERIAL BRASS MFG. Co., 1200 W. Harrison St., Chicago, Ill. Booklet 571, covering welding, cutting, and soldering equipment. 32

Variable-Speed Transmission and Motor Bases

IDEAL COMMUTATOR DRESSER Co., 1011 Park Ave., Sycamore, Ill. Bulletin covering variable-speed transmission and motor bases. 33

Burnishing Materials

H. LEROY BEAVER, Lansdale, Pa. Circulars descriptive of Beaverbright metallic burnishing materials, burnishing soaps, and Leroix burnishing soap compound. 34

Shell Threading and Tapping Equipment

LANDIS MACHINE Co., INC., Waynesboro, Pa. Folder illustrating and describing equipment for shell threading and tapping. 35

Thread Grinding Machines

EX-CELL-O CORPORATION, 1212 Oakman Blvd., Detroit, Mich. Twelve-page folder entitled "Ex-Cell-O Sets the New Standard with Precision Thread Grinding." 36

Welding Electrodes

WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. Bulletin 26-645, on "Crucible-Weld" Flexarc welding electrodes for every industrial requirement. 37

Welding Equipment

AIR REDUCTION SALES Co., 60 E. 42nd St., New York City. Catalogue 103, covering the complete line of Airco electrodes and Wilson electric welding machines. 38

Speed Reducers

JANETTE MFG. Co., 556 W. Monroe St., Chicago, Ill. Bulletin 22-8, entitled "Power Applications Simplified by Using Janette Motorized Speed Reducers." 39

Collets and Screw Machine Tools

MODERN COLLET & MACHINE Co., Ecorse, Mich. Catalogue 40, containing data covering lathe collets, pushers and tubes, screw machine tools, etc. 40

Flexible-Shaft Equipment

R. G. HASKINS Co., 617 S. California Ave., Chicago, Ill. Forty-page catalogue covering the company's complete line of flexible-shaft equipment. 41

Electric Instruments

WHEELCO INSTRUMENTS Co., 1929 S. Halsted St., Chicago, Ill. Bulletin S2-2, on thermo-couples and wire, lead wire, insulators, and protecting tubes. 42

Spray Equipment

ECLIPSE AIR BRUSH Co., INC., 398 Park Ave., Newark, N. J. Catalogue 77, descriptive of spray equipment for both manual and automatic operation. 43

Milling Machines and Jig Borers

MACHINERY MFG. Co., Box 35, Vernon Branch, Los Angeles, Calif. Circular on Vernon high-speed precision vertical milling machine and jig borer. 44

Variable-Speed Transmissions

REEVES PULLEY Co., Columbus, Ind. Folder illustrating and describing applications of Reeves speed control. 45

Lubricants

ACHESON COLLOIDS CORPORATION, Port Huron, Mich. Technical Bulletin 130-D, entitled "Colloidal Graphite as a High-Temperature Lubricant." 46

Rotary Burs and Files

MARTINDALE ELECTRIC Co., Box 617, Edgewater Branch, Cleveland, Ohio. Folder illustrating the company's line of rotary files and burs. 47

Engraving Machines

GEORGE GORTON MACHINE Co., Racine, Wis. Catalogue describing the complete line of Gorton pantograph engraving machines. 48

Die-Casting Machines

G & M MFG. Co., 11610 Madison Ave., Cleveland, Ohio. Loose-leaf catalogue describing the new G & M precision die-casting machine. 49

Die Steels

JESSOP STEEL Co., Washington, Pa. Bulletin containing information on the heat-treatment and applications of two types of die steel. 50

Electric Motors

ALLIS-CHALMERS MFG. Co., Milwaukee, Wis. Bulletin B-6033, on synchronous coupled and engine type motors. 51

Screws, Bolts, and Nuts

PHEOLL MFG. Co., 5700 W. Roosevelt Road, Chicago, Ill. 1940 catalogue, covering a complete range of screws, bolts, nuts, and washers. 52

Metallizing Equipment

METALLIZING Co. OF AMERICA, INC., 562 W. Washington Blvd., Chicago, Ill. Booklet on the metallizing process and equipment. 53

New and Rebuilt Machinery

J. L. LUCAS & SON, INC., 3 Fox St., Bridgeport, Conn. Bulletin 106-S, listing the new and rebuilt machines available through this concern. 54

Electric Lighting Equipment

GENERAL ELECTRIC Co., Nela Park, Cleveland, Ohio. Four-page folder on fluorescent Mazda lamps. 55

Forming Machinery

FARNHAM MFG. Co., 11 W. 42nd St., New York City. Circulars illustrating and describing different types of forming rolls. 56

Oilers

GITS BROS. MFG. Co., 1858 S. Kilbourn Ave., Chicago, Ill. Bulletin 10, on sight gravity- and wick-feed oilers. 57

Rotary Pumps

FAIRBANKS, MORSE & Co., Chicago, Ill. Bulletin 5135, on rotary pumps for positive, steady, and continuous flow. 58

Flexible Metal Hose

CHICAGO METAL HOSE CORPORATION, Maywood, Ill. Catalogue G-21, on Rex-Weld and Rex-Tube flexible metal hose. 59

Wrenches

BLACKHAWK MFG. Co., 5325 W. Rogers St., Milwaukee, Wis. Catalogue 240, covering all types and sizes of wrenches. 60

Roll Grinders

MESTA MACHINE Co., P.O. Box 1466, Pittsburgh, Pa. Catalogue illustrating and describing roll grinding machines. 61

Rotary Pumps

GEORGE D. ROPER CORPORATION, Rockford, Ill. Catalogue 939, giving complete engineering data on rotary pumps. 62

To Obtain Copies of New Trade Literature

listed on pages 209-212 (without charge or obligation), mark with X in the squares below, the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76

Name........................ *Position or Title*........................

[This service is for those in charge of shop and engineering work in manufacturing plants.]

Firm........................

Business Address........................

City........................ *State*........................

[SEE OTHER SIDE]

Flexible-Shaft Machines

STOW MFG. CO., INC., Binghamton, N. Y. Catalogue 40, covering various new Stow flexible-shaft machines and attachments. 63

Shell-Holding Equipment

LOGANSPORT MACHINE, INC., Logansport, Ind. Bulletin covering air and hydraulic shell-holding equipment. 64

Industrial Cleaners

SUN OIL CO., Philadelphia, Pa. Folder on Sunoco spirits, an all-purpose solvent and cleaner for industry. 65

Self-Locking Nuts

ELASTIC STOP NUT CORPORATION, 2332 Vauxhall Road, Union, N. J. Bulletin on elastic stop self-locking nuts. 66

Spray Painting Equipment

DEVILBISS CO., Toledo, Ohio. Thirty-two page booklet entitled "ABC of Spray Painting Equipment." 67

Industrial Wiring

GENERAL ELECTRIC CO., Schenectady, N. Y. Catalogue 51-919, entitled "Adequate Wiring for Industry." 68

Rheostats

REX RHEOSTAT CO., 37 W. 20th St., New York City. Catalogue R, on tubular slide-contact, protected-type rheostats. 69

Chain Belt Conveyors

CHAIN BELT CO., Milwaukee, Wis. Bulletin 370, on chain belt conveyors for foundry and machine shop use. 70

Wick-Feed Oilers

TRICO FUSE MFG. CO., 2952 N. Fifth St., Milwaukee, Wis. Bulletin 27, on unbreakable wick-feed oilers. 71

Speed Reducers

D. O. JAMES MFG. CO., 1120 W. Monroe St., Chicago, Ill. Catalogue 18, on motorized speed reducers. 72

Multiple-Spindle Drill Heads

B. M. ROOT CO., York, Pa. Bulletin 112, illustrating and describing multi-spindle drill heads. 73

Safety Equipment

BOYER-CAMPBELL CO., 6540 Antoine St., Detroit, Mich. Catalogue entitled "Everything for Safety." 74

Dust-Collecting Equipment

PANGBORN CORPORATION, Hagerstown, Md. Folder on industrial dust control equipment. 75

Mechanical Rubber Products

B. F. GOODRICH CO., Akron, Ohio. 24-page catalogue on rubber products for industry. 76

Trade Training by Motion Pictures

A new type of sound motion pictures has been brought out by the Film Productions Co. These pictures are expected to aid in the training of the great number of mechanics that will be needed in carrying out the new National Defense Program. These motion pictures contain no entertainment material of any kind; they simply provide practical instruction in various phases of mechanical work, such as die- and tool-making, precision measuring and lay-out methods, machine tool set-ups and operation, and similar subjects. In connection with these pictures, use is made of animated drawings, slow motion pictures, etc. Trade schools, engineering schools, and manufacturers interested may communicate with the Film Productions Co., 1504 Hennepin Ave., Minneapolis, Minn.

* * *

Progressive American business leaders have sold their merchandise and services to the American people in the pages of newspapers. Business has not sold either an understanding or an appreciation of the part it has played in the establishment of the highest living standard in the world. That job remains to be done. *Business, not Politics, developed America.—New York World-Telegram*

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 213-228 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment mark with X in the squares below, the identifying number found at the end of each description on pages 213-228—or write directly to the manufacturer, mentioning machine as described in July MACHINERY.

81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98
99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 206-207, mark with X in the squares below, the identifying number found at end of each description on pages 206-207—or write directly to the manufacturer, mentioning name of material as described in July MACHINERY.

201	202	203	204	205	206	207

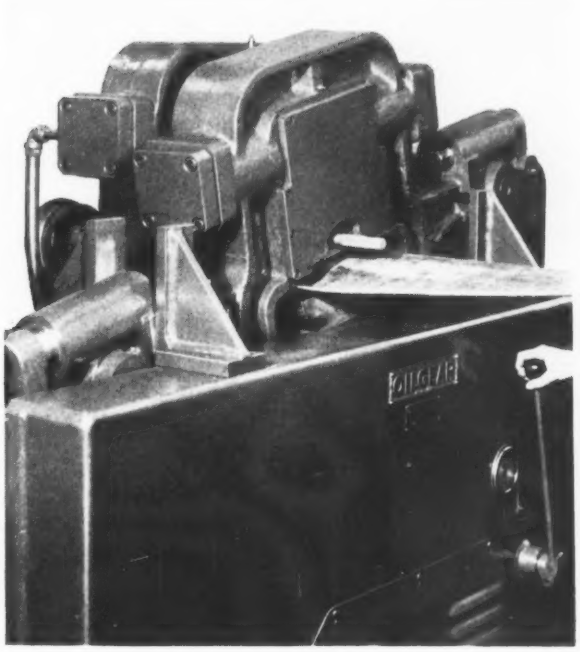
Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market



Oilgear Propeller Twisting Machine

A new fluid-power, variable-speed, propeller twisting machine, in which the most recent developments in control and operating equipment have been incorporated, has been brought out by the Oilgear Co., 1315A W. Bruce St., Milwaukee, Wis. This machine is designed for twisting airplane propeller blades ranging from 7 to 14 inches in width, as required to correct inaccuracies in the pitch. This permits the blades to be forged very nearly to size, so that only a small amount of stock need be removed by the finishing operations. The machine will maintain the axis of the twist upon the longitudinal center line of the propeller blade, and can be operated in either direction for increasing or decreasing the pitch of a blade.

The outstanding features of the machine are simple, push-button control of the fluid power clamps in the stationary and twisting supports; hand-lever, pilot follow-up control of the speed and direction of the twisting support movement; Oilgear two-way, variable-displacement, heavy-duty, piston, fluid-power pump, with simplified piping and oil circuit in which no external control or relief valves are required; and stationary and twisting clamp supports with integral clamping and unclamping cylinders.

Easy operation and control of the machine are possible with the simple lever and push-button control. The airplane propeller blade is loaded from the back of the machine and threaded through the stationary clamp and twister clamp to the point to be twisted. The operator depresses the push-button control and the stationary clamp closes on the propeller blade under low pressure. If the propeller is in the proper position, the operator depresses the other push-button control and the twister clamp closes on the propeller under low pressure. If the propeller is to be twisted clockwise, the hand-lever is moved to the right. If the propeller is to be twisted counter-clockwise, the hand-lever is moved to the left.

Oilgear Propeller-blade Twisting Machine

Pressure on the stationary and twister clamps automatically increases in direct proportion to the pressure required to twist the propeller. When the proper twist has been imparted, the push-buttons are depressed to open the clamp. The hand-lever is then released, and the twister support automatically returns to a preset horizontal position on the same axis as the stationary clamp support. The propeller is moved inward or outward to perform twisting operations on other sections of the blade. The center distance be-

To obtain additional information on equipment described on this page, see lower part of page 212.

tween the stationary and twisting clamp supports can be varied from 7 to 10 inches to change the length of the twist imparted to the blade.

The machine exerts a torque of 530,000 inch-pounds, and the twister clamp has a movement of 24 degrees or 12 degrees each side of the center position. It occupies a floor space of 81 by 29 inches, has an over-all height of 75 inches, and a shipping weight of 7610 pounds. 81

South Bend 10-Inch Tool-Room Lathe

A new 10-inch swing, Series S, tool-room bench lathe designed for high efficiency in performing precision operations on small work has recently been brought out by the South Bend Lathe Works, 724 E. Madison St., South Bend, Ind. This lathe is mounted on a welded-steel bench developed to provide the rigidity and stability of a floor type lathe, combined with the convenience and space-saving advantages of a bench lathe. Handwheels of large diameter, clear-cut easily read graduations, and conveniently arranged controls facilitate operation and lessen operator fatigue. The motor and driving mechanism are mounted under the headstock in the left end of the bench. The cone pulley belt passes up through the bed to the headstock. Back-gears provide slow spindle speeds and ample power for machining work of large diameter. A convenient belt-tension release lever and wrenchless gear-lock permit rapid changing of spindle speeds.

There is a 1 3/8-inch hole through the headstock spindle which can be equipped with either a hand-lever or handwheel type draw-in collet chuck for collets up to 1-inch capacity. Twelve spindle speeds ranging from 50 to 1357 R.P.M. are provided by standard motor drive equipment. Special drive equipment is available for higher spindle speeds. A full quick-change gear mechanism provides power longitudinal carriage feeds of 0.0015 to 0.0836 inch, power cross-feeds of 0.0006 to 0.0313 inch, and forty-eight right- and left-hand screw threads from 4 to 224 per inch.

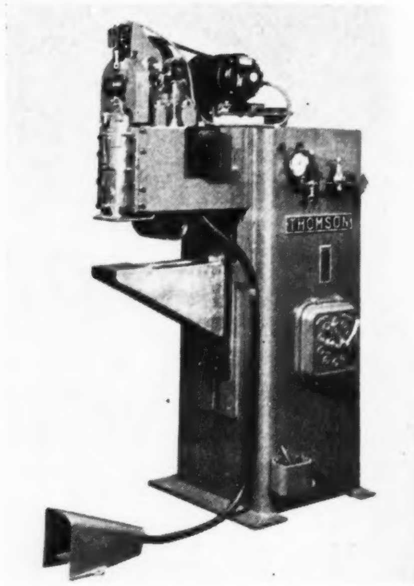
The spindle runs in journals that are superfinished to a smoothness of 5 micro-inches. The spindle nose has an 8-pitch precision screw thread 2 1/4 inches in diameter with a ground shoulder that insures interchangeability of chucks and faceplates.

This lathe is made in four bed lengths ranging from 3 to 4 1/2 feet, with center distances of from 16 3/8 to 34 3/8 inches. Tool-room attachments supplied with the lathe include handwheel type draw-in collet chuck, telescopic taper attachment, micrometer carriage stop, and thread dial indicator. 82

South Bend Tool-room Lathe Mounted on Welded-steel Bench

Thomson Welding Press

The 1940 Model No. 1 welding press recently brought out by the Thomson-Gibb Electric Welding Co., Lynn, Mass., has been designed to retain the advantageous features of previous welders made by the company and to embody several new ones. Adaptability is an important feature of the new welding press. A machine with a standard spring pressure head can, for example, be quickly converted to an air-locked head type, or a machine with an apron-mounted lower arm can be readily changed to a column-mounted type or to the knee type machine for use in projection welding.



Thomson Welding Machine with Air-locked Head and Lower Knee

The standard unit consists of a fabricated steel frame which houses the transformer. A 1/2-H.P. motor driving a worm reducer through a variable-speed pulley and belt operates the pressure cam. The cam acts directly on the head slide to which the upper welding electrode is attached, and is especially designed to provide a cushioning action, which prevents the occurrence of so-called "electrode hammer."

The regular equipment includes a precision type limit switch for starting the current flow. The limit switch is closed and opened by adjustable multi-leaf fan cams which can be used to time the welds accurately and directly through a contactor or through an auxiliary timing device.

The variable-speed pulley provides infinite speed selection between the regular ranges of 36 to 109 and 44 to 133 strokes per minute. The press is designed to operate at electrode pressures up to 1000 pounds. This applies to machines with 12-, 18-, 24-, or 30-inch standard throat depths. The welding press shown in the illustration, like the entire No. 1 press series manufactured by this company, is now regularly equipped with the new patented Thomson tubular secondary water-cooled transformer. 83

To obtain additional information on equipment described on this page, see lower part of page 212.

Pratt & Whitney Deep-Hole Drill Sharpener

Pratt & Whitney, Division Niles-Bement-Pond Co., West Hartford, Conn., have developed a new machine for sharpening deep-hole drill tips that is designed to eliminate haphazard hand-sharpening methods, which are not accurate enough to produce the longest possible drill life and the best drilling results. Pratt & Whitney, as a large manufacturer and user of both deep-hole drilling machines and drills, made an extensive study to determine the drill tip angles that produce the best results and applied the knowledge gained by this research in the development of the deep-hole drill sharpener shown in Figs. 1 and 2.

This machine will grind deep-hole drills from 3/16 to 5/8 inch diameter with the correct relief, proper clearance for the bevel and flat, and with smooth cutting edges. The roughing, finishing, and general-purpose grinding wheels are all driven directly by a 1/3-H.P. motor. The coolant system has a pump and a 1/6-H.P. motor mounted at the rear of the pedestal. The coolant and spindle motors are connected to the same starter and operate together.

The drill to be sharpened is inserted in a drill bushing and cam, which are mounted on a rocker. Four removable bushings and cams of different sizes and pitches are furnished with the machine. The face of the cam contacts with a cam abutment to insure the correct helix and dwell positions. An adjusting nut at the front of the rocker feeds the entire rocker unit on a threaded shaft either toward or away from the grinding wheel. This shaft is fastened to the elevating shaft, which provides vertical adjustment through a nut to obtain the desired relief at the cutting edge. Means for step-grinding are available, although this may require a slightly harder grinding wheel.

The rocker housing contains a worm-shaft which swings the entire unit around a gear on the threaded rocker-shaft. This furnishes the means for moving the work from the roughing to the finishing wheel, and also acts as a sidewise feed. The diamond for dressing the roughing and finishing wheels is mounted on the rocker. The entire rocker unit can be swiveled about the elevating shaft and clamped in the desired position, a graduated dial indicating the amount of the swiveling movement. By this means, the wheels can be dressed to the proper angle.....84

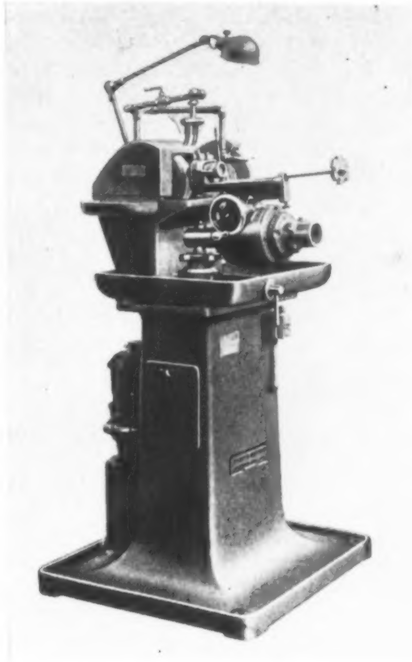


Fig. 1. Pratt & Whitney Deep-hole Drill Sharpening Machine

Hybco Tap-Grinder

A new Model 600 Hybco tap-grinder for sharpening taps on the chamfer, flutes, and spiral or gun points has been added to the line of tap-sharpening equipment made by Henry P. Boggis & Co., 410 W. Lakeside Ave., Cleveland, Ohio. This grinder has a capacity for sharpening taps in sizes from No. 1 machine screw taps up to 5/8-inch taps having two, three, or four flutes.

The wheel on the left-hand side of the grinder is used for sharpening the taps on the chamfer. The taps are held in precision collets, the maximum hole size being 0.500 inch. The collet grips the tap on either the thread or shank. The head can be swiveled to produce any chamfer angle, being set by employing the 90-degree graduations on the base. A stop-pin in the spindle and a locating finger on the head establish the correct relationship between the flutes and the relieving cams.

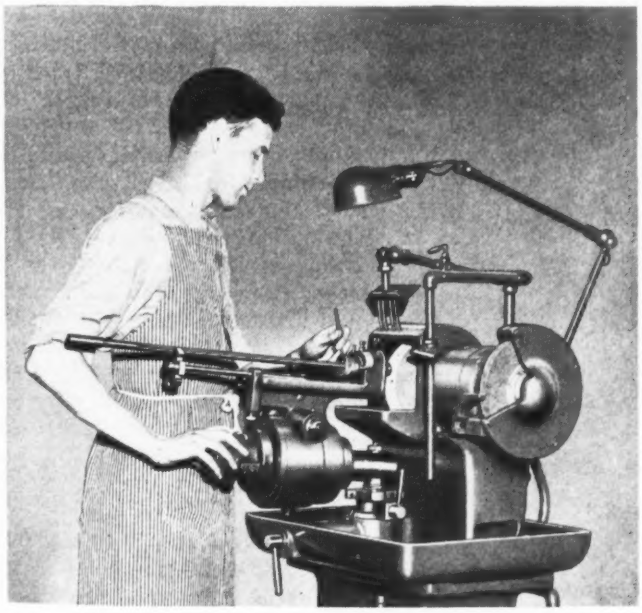


Fig. 2. Sharpening Tip of Deep-hole Drill on Machine Shown in Fig. 1

New Tap-grinder Placed on the Market by Henry P. Boggis & Co.

To obtain additional information on equipment described on this page, see lower part of page 212

Three hardened, adjustable, relieving cams that run in oil inside the head are operated by screws at the back of the head. These three screws set the head for two-, three-, or four-flute taps, and serve to control the amount of relief. For changing taps in the collet, the head can be swung back away from the grinding wheel. A diamond dresser is furnished for truing the wheel.

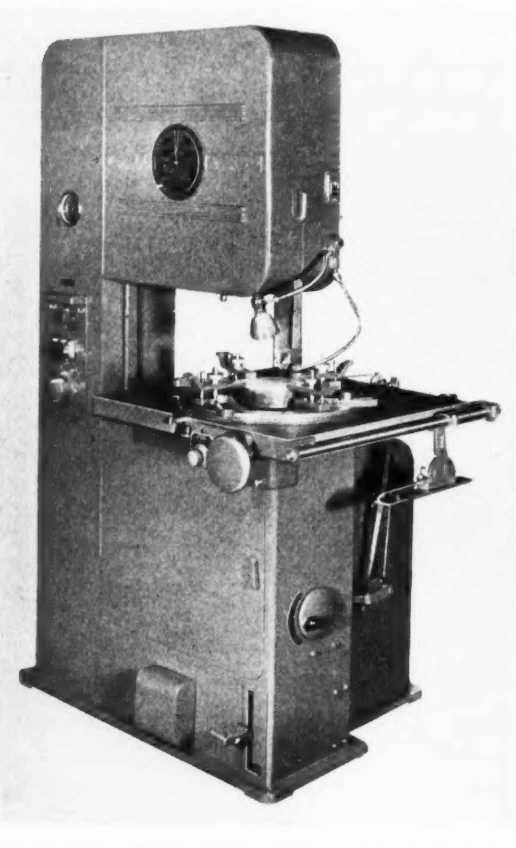
The wheel on the right-hand side of the grinder is employed for sharpening flutes and for grinding special points. The spindle, using the same collets as the chamfering head, is mounted on a vertical slide operated by the handle at the front of the grinder. A diamond dresser which can be set accurately with a 2-inch micrometer, is furnished for forming the wheel to any desired radius. The chamfering head and slides have stops to enable any number of taps to be ground to the same length, as required for multiple tapping. 85

"Super Doall" with New Work Feed

A new metal-cutting band saw designated the "Super Doall" has been brought out by Continental Machines, Inc., 1312 S. Washington Ave., Minneapolis, Minn. A feature of this machine is the work feed, which not only draws the work to the saw, but also enables the curvature of the cut to be mechanically controlled by a handwheel. The mechanical control eliminates the necessity for guiding the work by hand. Saws up to 1 inch wide, as well as the usual range of narrow saws from 1/16 to 1/2 inch in width, such as are used in contour sawing, can be employed. A full set of Doall saw guides is furnished. These guides can be placed close to the work, both above and below the part being sawed. These adjustable guides are designed to securely hold bands of any thickness.

The machine is furnished with three widths of file bands, namely 1/4, 3/8, and 1/2 inch. An assortment of twenty-one types of file bands is available in these three widths. Three abrasive polishing bands of 1-inch width are also furnished in graphite-impregnated, canvas-backed, Carborundum grits of Nos. 50, 80, and 150. The 1 1/2-H.P. driving motor is enclosed in the base, and there is a 1/4-H.P. motor mounted on the column for operating the grinder for the automatic butt welder.

The cabinet furnished as standard equipment provides storage for saws, file bands, and other supplies. The new model is furnished complete with cut-off and mitering attachment, automatic disk cutting attachment, ripping fence, electric etching pencil, table tilting compensator, and a heavy work-slide. 86



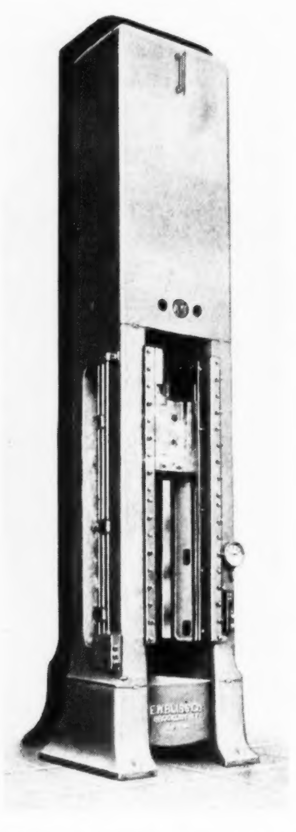
"Super Doall" Metal-cutting Band Saw with New Work Feed

Bliss Hydro-Dynamic Press for Redrawing Cartridge Cases

The Hydraulic Press Division of the E. W. Bliss Co., 53rd St. and Second Ave., Brooklyn, N. Y., has just brought out a 100-ton Hydro-Dynamic long-stroke, reducing press of streamline design. This single-action, self-contained press is furnished with the Bliss oil operating system designed for fast speeds. An all-electric control, as well as a direct pumping unit is employed in the press illustrated. The fast acting valve system of this machine permits pressure control over a wide range, as required in redrawing cartridge cases.

Pressure switches are furnished to prevent injury to the dies from excessive stresses. Finger-tip control by means of push-buttons permits easy and safe die setting, 1/32-inch movements being readily obtained. The new press is of four-piece tie-rod frame construction, with keyed and fitted sections of hard high-test irons. Automatic control is obtained by positioning three adjustable stops on the inner side of the machine. These stops can be adjusted quickly by a hand-crank at the front of the machine.

Changes from rapid advance to the high-pressure working stroke, and to quick return, etc., can be accomplished quickly and smoothly. The maximum stroke of the press is 84 inches. The front-to-back measurement of the bed is 30 inches, and the right-to-left measurement 31 inches. 87



Bliss 100-ton Long-stroke Reducing Press

Stainless-Steel Hydraulic Valve

The Albright Equipment Co., 923 Crafts Bldg., Pittsburgh, Pa., has brought out a new series of valves, designated "Hydra," for use in hydraulically actuated machines. These valves can be used in water, steam,

To obtain additional information on equipment described on this page, see lower part of page 212.

and oil lines having pressures up to 4000 pounds per square inch. One of the principal features is the ease with which these valves can be operated, only one-eighth turn of the operating handle being required to open or close the valve.

The four stainless-steel balls that close the valve are automatically seated in port holes by the line pressure. There are no valve seats to regrind, and consequently no necessity for removing the valves for repairs. The internal parts are of stainless-steel construction. These valves can be operated by hand or by electric solenoids with push-button control. They are made with bodies of three different materials, namely, brass, bronze, and steel. The standard sizes range from 1/2 to 2 inches, but larger sizes can be supplied. 88

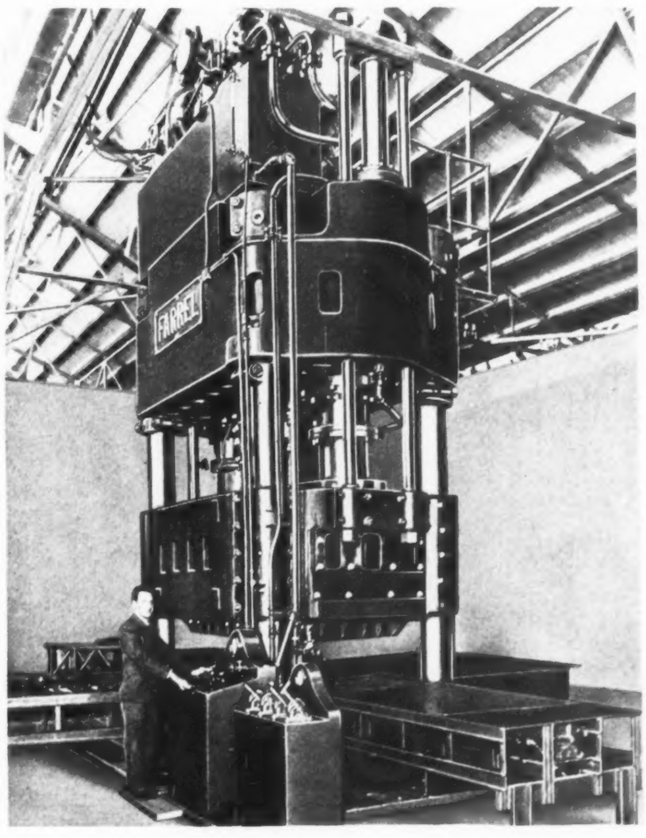
Presses for Forming Metal Aircraft Parts

The Farrel-Birmingham Co., Inc., Ansonia, Conn., has recently built several presses of 2200 tons capacity for blanking and forming duralumin parts for all-metal airplanes. These presses are among the largest used for metal-forming in the aviation industry. Each press weighs upward of 175 tons and stands nearly 26 feet high. Although the maximum capacity of these presses is 2200 tons under a hydraulic pressure of 2500 pounds per square inch, acting on one 38-inch ram and two 20-inch rams, the pump control is of such design that a wide range of hydraulic pressures can be obtained by simple adjustments at the control panel. Two 10-inch diameter, single-acting, push-back rams raise the moving platen to the open position.

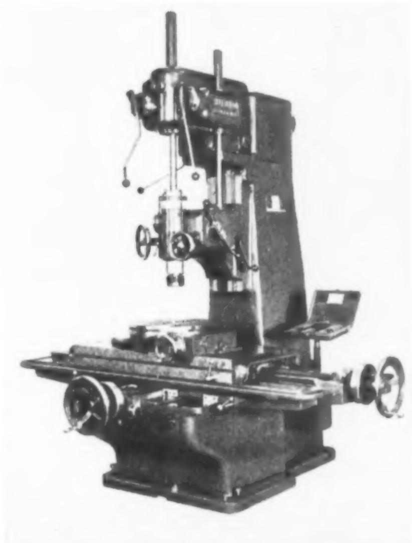
An important feature of the press illustrated is the conveyor tables located on four sides of the press. These tables facilitate loading and unloading, and thus make it possible to keep the press operating at maximum capacity. The tables are equipped with a movable platen on which dies are mounted and carried into and out of the press. The platens are controlled from a main desk beside the press control desk. The stroke of the conveyor cylinders is so controlled that the platen registers uniformly on the press bolster. The conveyors can be readily removed to permit the use of large dies which may occupy the full length and width of the press.

The clear space available between the tie-rods of these large presses is 61 inches wide by 97 inches long. The over-all dimensions of the bottom of the cross-head and of the moving platen are 96 by 133 inches. The presses are designed with a maximum opening of 60 inches and a maximum stroke of 36 inches. Provision is also made to reduce the maximum opening to 38 inches. The closing speed is variable from 1 to 130 inches per minute, with a pressing speed of from 1 to 12 inches per minute. The traverse or return is about 130 inches per minute.

The power generating equipment, consisting of a motor-driven pump, valves, piping, and oil storage tank, is mounted on top of the press. The hydraulic pressure pump is of the rotary piston type, with variable pressure control and is driven by a 150-H.P., 900-R.P.M. motor. 89



Huge Farrel-Birmingham Press with Conveyor Tables on Four Sides, for Blanking and Forming Airplane Parts



Cleereman Jig Borer with Power Rapid Traverse for Longitudinal and Transverse Movements

Cleereman Jig Borers with Power Rapid Traverse

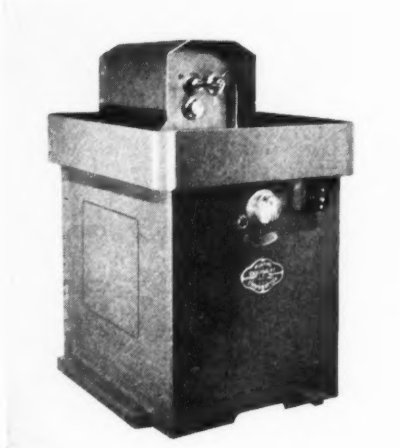
Cleereman jig borers manufactured by the Cleereman Machine Tool Co. and sold through its sales division, the Bryant Machinery & Engineering Co., 400 W. Madison St., Chicago, Ill., are now available with power rapid traverse to the table and carriage. This consists essentially of a built-in motor which drives the screw through worm-gearing, a small reversing drum switch being used in conjunction with a magnetic reversing controller to control the motor and limit switches and prevent over-travel. Power rapid traverse is available for either the longitudinal travel only, or for both the longitudinal and transverse movements.

A two-jaw positive clutch is employed for engaging either the hand-traverse handwheel or the power rapid-traverse worm-gear. When the power rapid traverse is engaged, the hand-traverse handwheel is disengaged. The fine-feed handwheel is located at the end of the vertical motor-shaft and utilizes the same worm and gear as the power rapid traverse. With this construction, it is possible to engage the power rapid-

To obtain additional information on equipment described on this page, see lower part of page 212.

traverse clutch and leave it engaged indefinitely without using the hand-traverse handwheel. Approximate settings are made with the power rapid traverse by merely operating a switch, the final precise adjustment of the table being made by means of the fine-feed handwheel.

On machines fitted with end-measuring rod equipment, one limit switch is built into the dial-indicator housing to stop the rapid-traverse motor just before the measuring rods come in contact with the anvil of the dial indicator. The final fine adjustment is then made by means of the fine-feed handwheel. With this equipment, operator fatigue is materially lessened and set-up time reduced to a minimum. 90



Honing Machine Developed by the Honing Equipment Corporation

Phoenix-Lester Die-Casting Machines

The Lester Engineering Co. and the Phoenix Machine Co., 2711 Church Ave., Cleveland, Ohio, have brought out two new die-casting machines for producing aluminum, brass, and magnesium alloy die-castings. These machines are similar in design, but of different sizes. The HHP-2X machine will produce castings up to 2.2 pounds in aluminum and 6 pounds in brass. The HHP-3X machine will produce castings up to 3.3 pounds in aluminum and 9 pounds in brass. The melting pot and injection plunger can be changed quickly to adapt the machines for handling tin, zinc, and lead alloy castings.

These machines are built with solid beams in place of tie-bars, and adjustment of the mold is obtained through a worm and screw. These two features keep the mold platens in a parallel position and insure accurate alignment. Positive mold-locking pressures up to 800,000 pounds are obtained with the link lock toggle system. The speed of the injection plunger and the pressure on the metal can be controlled. The sequence of operations is electrically controlled, as is also the timing of each operation. A hydraulic system that develops tremendous pressure and maintains it throughout the operating cycle is used in place of the conventional accumulator bottle. Pressure upon the metal increases with increasing resistance, resulting in castings of uniform density.

A limit switch is employed to prevent the injection plunger from functioning unless the die is closed and locked. The operating lever is so designed that any movement can be quickly reversed. The smaller of the two machines weighs 12,000 pounds, while the larger size weighs 19,000 pounds. 91

Honing Machine for Small Cylindrical Work

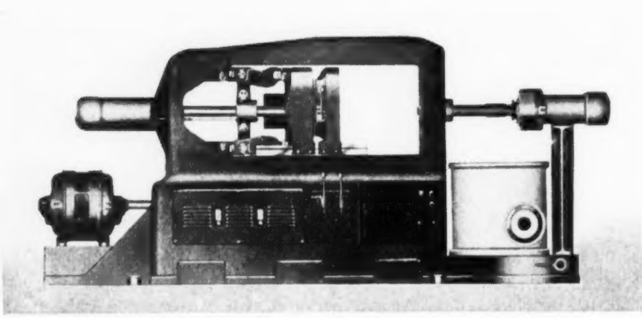
A machine for honing small internal and external cylindrical surfaces ranging from 1/4 inch to 2 inches or more in diameter, where the part is not too heavy or cumbersome for the operator to hold in his hands, has been developed by the Honing Equipment Corporation, 7207 E. McNichols Road, Detroit, Mich. Several machines of this new design are being used with satisfactory results for honing small airplane parts and die sets on which close tolerances are maintained.

The machine is started by pressure on the foot-pedal, which automatically releases an electric brake, actuates the switch for starting the motor, and expands the honing abrasives to the desired diameter. The honing tool comes up to speed instantly, and the operator reciprocates the workpiece by hand. Upon completing the honing, the operator removes his foot from the pedal. This causes the honing abrasive to retract and the motor to stop automatically, the brake serving to stop the spindle rotation instantly, so as to permit removal and replacement of the work.

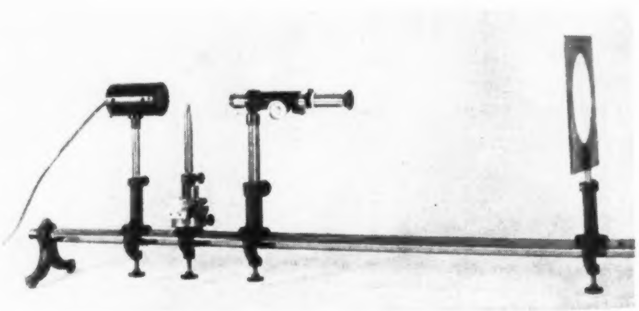
A hand-knob at the front of the machine enables the operator to obtain any spindle speed from 550 to 2000 R.P.M., the speed selected being shown by a pointer. The coolant is pumped from the removable reservoir in the base through a filter to the honing tool, and returned to the reservoir. The pump is driven by a separate motor. This machine requires a floor space of approximately 31 by 41 inches, and weighs about 1500 pounds. 92

Projection Comparator Assembled from Standard Optical Parts

A projection comparator for the examination of small parts which will give a magnification of fifty times or more, can be easily assembled from standard optical bench parts made by the Gaertner Scientific Corporation, 1201 Wrightwood Ave., Chicago, Ill., for use in research laboratories. A projector assembled in this manner has three



Phoenix-Lester Die-casting Machine Built in Two Sizes for Producing Aluminum and Brass Die-castings



Projection Comparator Assembled from Standard Optical Parts Made by Gaertner Scientific Corporation

To obtain additional information on equipment described on this page, see lower part of page 212.

major advantages—the cost is low; the parts, being interchangeable, permit other equipment to be added as desired, usually without requiring machining operations; and the individual parts, such as the microscope, the high-powered lamp, and the swiveling clamp, have many important tool-room applications.

The projector shown in the accompanying illustration consists of a high-powered lamp, operating on a 6-volt transformer, which throws light into the horizontally mounted microscope. At the extreme right is a ground glass screen on which the image appears. Each of these parts is mounted on a detachable rod of a standard diameter, which has a good sliding fit in a right-angle clamp. The clamps are mounted on a long rod of square cross-section along which they can be adjusted. The square horizontal rod is provided with detachable end supports.......93

Hamilton Drafting Tables

The new "Stremeline" drafting tables with chrome-finished tubular steel bases, brought out by the Hamilton Mfg. Co., Two Rivers, Wis., are made in six sizes ranging from 36 by 48 inches to 42 by 72 inches. These tables have a comfortable footrest, 5 inches wide, which runs the entire width of the table. The feet are equipped with hard rubber shoes to protect the floor.

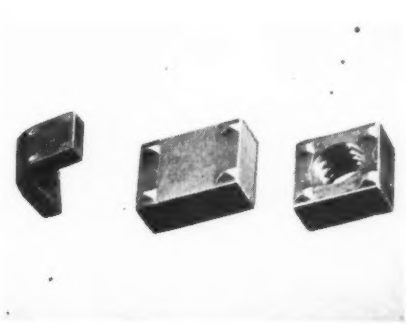
The drawing board can be instantly set at any angle. It is only necessary to close the release mechanism and then tilt the board to the desired angle. When the tilting lever is released, the board is positively locked. The height of the board is adjustable from 32 1/2 to 42 inches by means of four handwheels. When frequent changes in height are necessary, an auxiliary gear raising device operated by a crank can be supplied.......94

"Stremeline" Drafting Table Brought out by the Hamilton Mfg. Co.

Welding Nuts, Bosses, and Brackets

A line of new patented products consisting of rectangular nuts, bosses, and brackets with projecting welding pads on the face or faces to be joined to metal surfaces by electric resistance welding has been placed on the market by the Ohio Nut & Bolt Co., 600 Front St., Berea, Ohio. These small parts are suitable for use in the manufacture of a variety of machines and metal products. The welding brackets, bosses, or nuts should be made of the same material as the part to which they are to be welded.

Rectangular welding bosses are available in sizes ranging from 3/8 inch wide by 1 inch thick by 1/2 inch long up to 13/16 inch wide by 3/8 inch thick by 1 inch long. Rectangular welding nuts are available in a similar range of sizes, with threaded holes ranging from 1/8 to 5/8 inch in diameter. The brackets may have welding projections or pads on one or both angles, and the pads may be placed on either the outer or inner sides of the angles. Welding brackets are furnished with tapped holes in one or both of the sides or with drilled or reamed holes that can be used as bearings for either push-rods or revolving shafts.......95

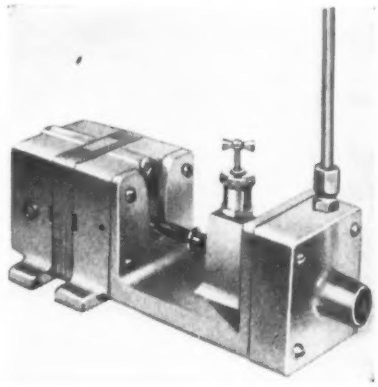


Welding Nuts and Brackets Made by the Ohio Nut & Bolt Co.

Speedway Small-Size Pumps

The Speedway Mfg. Co., 1834 S. 52nd Ave., Cicero, Ill., has developed two new rotary pumps for light industrial applications, such as pumping lubricant, and for laboratory use. These pumps can be furnished in various alloys for pumping different kinds of liquids. They are designed for quiet operation, and are coupled with a shaded pole type electric motor.

The Type O1, built integral with a motor, is designed for use only with light-bodied transformer oil. This unit is especially intended for use in the sump well of the oil container. It has a capacity for lifting oil 5 feet in a 3/16-inch diameter tube, with a delivery rate of one gallon in three minutes. This unit is 4 1/2 inches long, 3 1/2 inches high, and 4 inches wide.



Speedway Type O2 Pump and Motor Unit

The Type O2 pump is of the gland style and is designed for pumping water, all parts of the pump being rustproof. The housing is of aluminum, and the impeller blade and shaft are of stainless steel. This pump has a lifting capacity of 5 feet and delivers one gallon per minute under a head of 1 foot through a 1/4-inch tube, or one gallon in five minutes under a head of 5 feet.......96

Adjustable Gold-Stamping Machine

Numbers and markings in gold, silver, white, blue, red, orange, and various other colors can be stamped on fiber, wood, leather, celluloid, Bakelite, paper, plastics, and many other materials with the new adjustable stamping machine brought out by H. O. Bates, 251-257 N. Broad St., Elizabeth, N. J. This machine

H. O. Bates Stamping Machine for Marking Numbers in Colors

To obtain additional information on equipment described on this page, see lower part of page 212.

PARTS PRODUCTION
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SHARPE

is especially adapted for use in the aircraft industry for marking purposes. The particular machine shown in the illustration is used for marking, in gold, the number and code information on molded brake blocks. The new machines of adjustable construction permit stamping pieces up to 4 inches thick. Fixtures for use in handling a wide variety of parts can be made to order.

The machine can be operated by hand at speeds as high as twenty-five pieces or more per minute, depending upon the operator's skill and the material stamped. It can be furnished with heat control and a plug-in for use with the regular lighting circuit. 97

Crescent Portable Sheet-Metal Cutting Machine

The Crescent Machine Co., 10 Cherry Fork Ave., Leetonia, Ohio, has placed on the market a portable motor-driven machine for cutting sheet metal up to 3/32 inch thick. Aluminum castings are employed in the construction of this machine to keep the weight down to 71 pounds, including the detachable legs.

The machine proper is 18 inches long, 13 inches wide, and 8 inches high. It has an abrasive wheel about 8 inches in diameter which projects 1 3/4 inches above the table. This permits cutting tubing of any material up to 1 1/2 inches outside diameter. An 8-inch steel saw can be substituted for cutting boards up to 1 1/2 by 12 inches wide or ripping boards up to 6 inches wide. The 1/3-H.P. motor drives the arbor at a speed of 3500 R.P.M. through a V-belt. 98

Portable Sheet-metal Cutting Machine Made by the Crescent Machine Co.

"Metapost" Drafting Tables

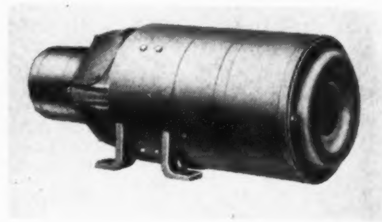
The Frederick Post Co., Box 803, Chicago, Ill., has recently placed on the market two new "Metapost" drafting tables of attractive design that can be quickly and easily adjusted for height and angle of inclination. The "Primo Metapost" table, shown in the accompanying illustration, can be adjusted quickly and smoothly by turning a free-operating handwheel that raises the working surface from 35 1/2 to 43 inches. The top of this table can be tilted to any angle up to 60 degrees by adjusting two hand-clamps.

"Primo Metapost" Drafting Table Designed for Easy Adjustment

The "Metapost" drafting table has the same adjustment features as the "Primo Metapost," with the exception that the top is raised manually after loosening two screws. Both tables have satin chrome-finished tubular steel frames, with the cast parts finished in black. 99

New Stone for Superfinishing and High-Speed Honing

The Mid-West Abrasive Co., 2188 Beaufait St., Detroit, Mich., has brought out a new abrasive stone for superfinishing work and high-speed honing. It is claimed that this stone has a uniform cutting surface, developed as the result of several years of laboratory experimental work. All grains of abrasive are bonded together in such a manner that each grain is separate and acts as an individual polishing unit. There is no possibility of several grains adhering and causing an uneven finishing action. 100



Motor-generator Set Unit of General Electric Speed-variator

General Electric Speed-Variator

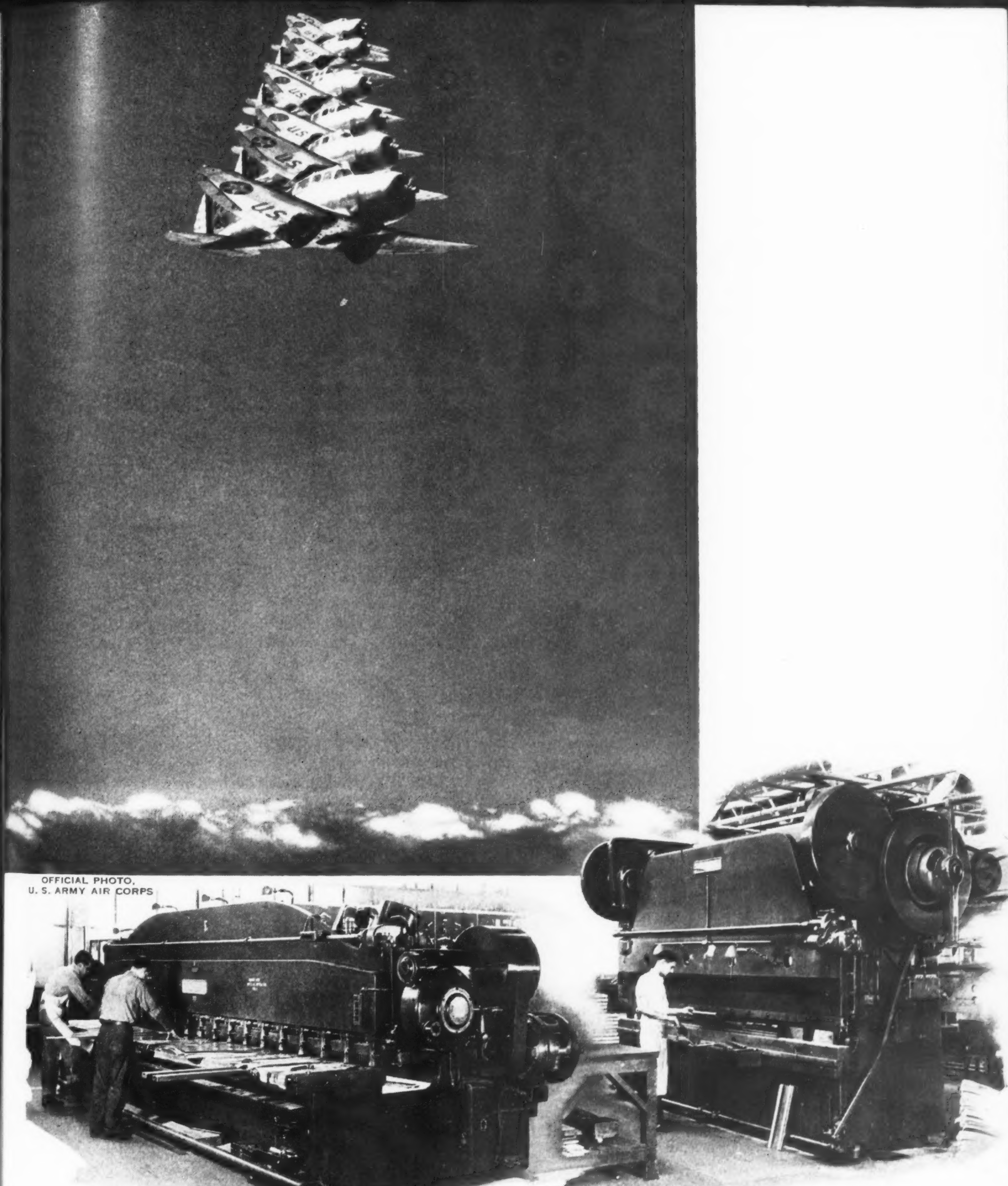
The General Electric Co., Schenectady, N. Y., has recently brought out a complete speed-variator unit operating from an alternating-current line to provide wide ranges of adjustable speed by means of the well-known generator-voltage-control arrangement. This equipment is adapted for driving machine tools, pumps, textile and paper machinery, etc., and is applicable to all kinds of material-handling operations. Heavy starting duty and slow threading speed, quick stopping, and fast acceleration, coupled with flexible control, are advantages claimed for this equipment.

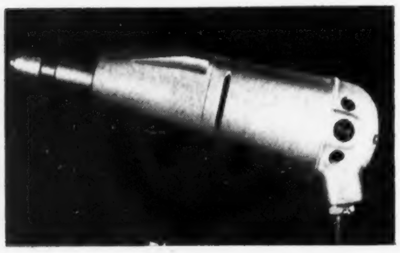
Each unit consists of an adjustable-speed, direct-current motor; an adjustable-voltage motor-generator set with control; and a separately mounted generator-field rheostat. Standard speed ranges are available in ratios up to 16 to 1. The motor can be mounted directly on the driven machine, with the speed-changing control located nearby. The units are designed to operate from three-phase, 60-cycle, 220-, 440-, and 550-volt alternating-current power. The potentiometer type of generator-field rheostat provides speed changes varying by small increments over a wide range. 101

H & H Multi-Purpose Reciprocating Tool

A portable, reciprocating tool, designated as Series C, has been brought out by the H & H Research Co., 1925 W. Buena Vista, Detroit, Mich. This new tool has a stroke length of 3/8 inch, and develops a 30- to 40-pound push or pull at the end of the chuck, which is more than three times that of previous models. It can be used for filing, burring, honing, snagging, polishing, sawing, and chipping operations. Under full load, this tool operates at a speed of 1250 to 1400 strokes per minute, and will handle a 3/4-inch square hone

To obtain additional information on equipment described on this page, see lower part of page 212.


OFFICIAL PHOTO,
U. S. ARMY AIR CORPS



Portable Reciprocating Tool Made by the H & H Research Co.

on heavy work, and a 7/16-inch hone on lighter work in confined places.

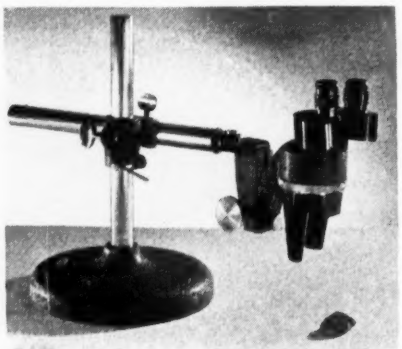
There is a complete kit of hones for spotting, finishing, and polishing most types of dies and molds, as well as for dressing the runways of lathes. Special, as well as standard, cut files can be used as required for snagging cast iron or soft metals, such as aluminum. The tool is powered with a 1/30-H.P. motor, and can be readily adapted for use either as a vertical or a horizontal filing machine. The chuck will hold 1/4-inch tools, and can be furnished with an adapter for 1/8-inch tools. 102

Sterling Motor-Driven Drill Grinder

The Sterling drill grinder here illustrated has been added to the line of universal tool and cutter grinders, cylindrical grinders, etc., built by the McDonough Mfg. Co., Eau Claire, Wis. This grinder is designed to permit drills to be ground accurately at low cost by simple operations that can be performed by the regular tool-room attendant. The tilting table and cup-wheel are suitable for grinding carbide or high-speed tool steel, and are especially adapted for grinding tools for lathes, shapers, planers, boring mills, etc., as well as for general shop purposes.

This drill grinder will sharpen drills having either two or three lips, in sizes ranging from 1/8 to 2 1/2 inches in diameter. The 1/2-H.P. motor has a speed of 3450 R.P.M. and operates on 220- to 440-volt, three-phase, 60-cycle current. The grinder is equipped with two 6-inch wheels, one with grit and grain suitable for grinding drills, and the other for grinding cemented-carbide or high-speed tools. 103

Sterling Drill and Tool Grinder Built by the McDonough Mfg. Co.



Stereoscopic Microscope for the Examination of Large Objects

Spencer Stereoscopic Microscopes

A new series of stereoscopic microscopes embodying notable optical and mechanical improvements is being placed on the market by the Spencer Lens Co., Scientific Instrument Division of the American Optical Co., Buffalo, N. Y. A vivid stereoscopic image that is easy on the eyes, a great depth of focus, an exceptionally large object field, and a high degree of resolution of fine detail that gives sharpness to the image are outstanding optical characteristics of this new series of instruments.

Important mechanical improvements facilitate focussing on large or small specimens and provide for quick changes in magnification. These instruments are of heavy, rigid design, and have the objective lenses mounted in a dustproof revolving holder.

The regular laboratory types have large heavy bases and stands. The stereoscopic microscope unit can be had mounted on a stand with a horizontal arm, as shown in the illustration. With this arrangement, the object can be observed anywhere within a radius of 4 feet. Magnifications range from 6.3 up to 144 times. Seven different powers in paired objectives, and four different powers in paired eye-pieces provide a total of twenty-eight magnifications. 104

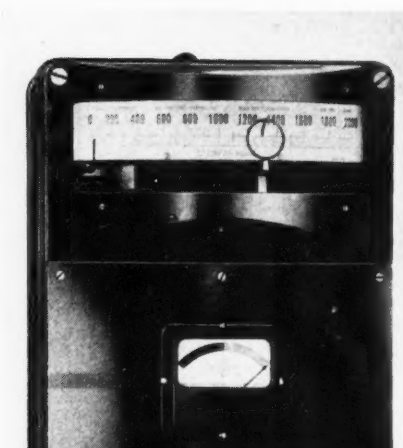
Pyralin-Tipped Mallets

The Southwest Mfg. Co., 1623 E. First St., Santa Ana, Calif., has brought out a new line of improved pyralin-tipped mallets. These mallets are made with bodies ranging in size from 3/4 inch up to 1 1/2 inches. Hammers of this kind are being used extensively in aircraft construction work. The tips of the hammers can be replaced by simply screwing in a tip of the required design, which may be straight-, cross-, or ball-pein, or flat. 105

Bristol Electronic Pyrometer Controller

Control is accomplished by means of a new electronic circuit using a single high-output vacuum tube of the all-metal type in a pyrometer controller developed recently by the Bristol Co., Waterbury, Conn. The all-metal tube used in this device has a useful life of several years. A milliammeter on the front of the instrument indicates the condition of the control circuit at all times.

This measuring unit is equipped with a cold-end compensator to insure accuracy. A Millivac relay serves to make the controller extremely sensitive to changes in temperature at the thermo-couple. The entire operating mechanism of the relay is enclosed in a vacuum. 106



Electronic Pyrometer Controller Made by the Bristol Co.

To obtain additional information on equipment described on this page, see lower part of page 212.

Throughout the AIRCRAFT Industry

THIS (SUPER C B SERVICE) TRADEMARK

MEANS "MORE HOLES PER DOLLAR"!

A FAMOUS RADIAL DRILL FOR A FAMOUS RADIAL ENGINE

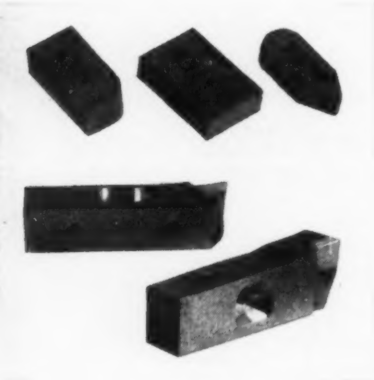
Today's need for speed and the aircraft industry's rigid demands for accuracy are two requisites fully satisfied by the Super Service Radial. The Wright Aeronautical Corporation, for example, finds in their Super Service Radials the opportunity to complete with ease, speed and economy the numerous and precise drilling, reaming, counterboring, facing and tapping operations required on the famed Cyclone and Whirlwind Aircraft Radial Engines. Here, where production schedules dare not lag, engineers and operators alike place full confidence in the ease-of-handling, the dependability, and the precision of the Super Service Radial. Management and labor are both more than satisfied; the former benefits from "more holes per dollar," the latter from the exclusive Cincinnati-Bickford fatigue-lowering features. And all industry benefits from the all 'round efficiency of the Super Service Radial.

Bulletins and complete details upon request.

Drilling and tapping oil sump attaching pad for a Wright Cyclone crankcase.

THE CINCINNATI BICKFORD TOOL CO.

OAKLEY · CINCINNATI · OHIO · U. S. A.



Kennametal Tungsten-Titanium Carbide Tips and Tools

New Kennametal Tool Tip Material

A new grade Kennametal tungsten-titanium carbide alloy in which unusual hardness is combined with great toughness has just been placed on the market by McKenna Metals Co., 147 Lloyd Ave., Latrobe, Pa. This hard tool alloy, known as Kennametal Grade K3H, is recommended as a tool tip material for light finishing cuts and for fairly heavy continuous cuts on steel of any hardness up to 550 Brinell. Tool tips of this material are supplied in the three standard shapes shown in the upper view of the accompanying illustration, or they can be obtained in special shapes to suit specifications. Tools on which tips have already been brazed are also available.

The new tip material has a hardness of 79.0 Rockwell C, and shows a strength of 210,000 pounds per square inch on the transverse rupture test. The boring tools tipped with K3H Kennametal shown in the lower view of the illustration produced from 200 to 225 pieces per grind when used for machining SAE 1020 forged and carburized steel at a speed of 406 feet per minute.......107

Abart Speed Reducer

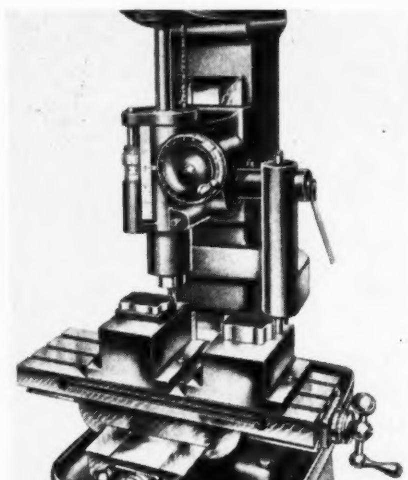
To supplement its line of speed reducers, the Abart Gear & Machine Co., 4832 W. 16th St., Chicago, Ill., has developed a new intermediate line of worm and worm-wheel reduction units designated Type 2 5/8A. The units in this new line weigh 22 pounds, have a base 7 1/2 by 5 inches, a height of 7 inches, and are capable of handling any inputs from 1/4 to 2 H.P. at 1800 R.P.M., and from 1/8 to 1 1/2 H.P. at 1200 R.P.M. The ratios range from 4 5/6 to 1 up to 100 to 1.......108

Bear Alternating-Current "Arcmaster" Welder

A new alternating-current "Arcmaster" welder, recently brought out by the Bear Mfg. Co., Rock Island, Ill., has a unique multiple-coil transformer design that assures an even flow of current to the electrode, and an improved safety construction that provides complete protection for the operator. The entire welder case is made of heavy cast aluminum to insure rapid heat dissipation. The unit is furnished in three models, with ranges of 10 to 200, 10 to 250, and 10 to 300 amperes. All models have 220, sixty-cycle voltages.......109

Profiling Attachment for Vernon Vertical Mill and Jig Borer

A profiling attachment for duplicating work in metal, plastics, patterns, and dies has been developed by the Machinery Mfg. Co., P. O. Box 155, Vernon Branch, Los Angeles, Calif., for use on the Vernon combination vertical mill and jig borer. The sliding head of this machine is so constructed that the attachment can be easily and quickly engaged or disengaged. This attachment has been developed especially for small-lot machining of irregular shaped forgings, but it is also applicable to contour milling, using wood, plaster, or plastic models. The attachment is easy to operate and provides an inexpensive means for duplicating a wide variety of molds and dies.......110

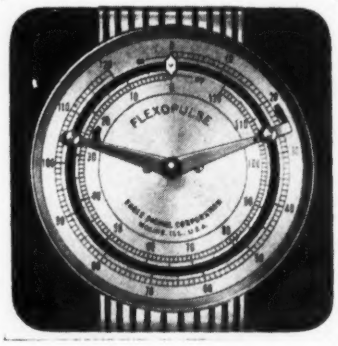


Vernon Jig Borer Equipped with Profiling Attachment

"Flexopulse" Repeating Cycle Timer

The "Flexopulse" repeating cycle timer, recently placed on the market by the Eagle Signal Corporation, Moline, Ill., utilizes the reversing action without reversal of the motor to provide an extreme range of contact in a continuous repeating series of operations. This device will control motors, lights, signs, gongs, valves, electric furnaces, temperature controls, and various other units. It is so designed that the cycle and percentage of contact closure time can be adjusted without changing gears or adjusting cams.

Three distinct models are available which provide ranges of 2 to 120 seconds; 20 seconds to 20 minutes; and 2 to 120 minutes. All models have 5 3/4-inch clock-face dials, with time adjustment arms for cycle regulation.......111



Repeating Cycle Timer

Sensitized Linen for Making Photoprint Tracings from Pencil Drawings

A sensitized linen that will reproduce a master positive copy from a pencil drawing, for use in every respect like a tracing, has been brought out by Hunter Electro-Copyist, Inc., Syracuse, N. Y. The copy is made by contact photoprinting in ordinary office light, completely eliminating the use of hand ink tracings. This new sensitized linen, known as "Heccotex," does not shrink or stretch when immersed, and therefore makes possible true-to-scale printing of blueprints or other types of drafting-room reproductions. It is available in 12-, 18-, 24-, and 36-inch rolls, as well as in cut sheets from 24 by 30 inches up to 30 by 42 inches.......112

To obtain additional information on equipment described on this page, see lower part of page 212.

GRINDING *after* HARDENING

provides the new maximum of accuracy for airplane engine threads . . . *by eliminating ALL heat-treat distortion*

● *To the right:* Two typical airplane engine studs (before and after) ground from the solid on Ex-Cell-O Precision Thread Grinders, after hardening. Large stud is precision ground on both ends; small stud precision ground on one end only, as shown.

PRECISION Thread Grinding is playing a major part in aiding the aircraft industry to meet the tremendous impetus created by today's fast-changing conditions. The extreme accuracy and finish now demanded by airplane engine manufacturers in threads for all vital parts . . . without sacrifice in production . . . is possible only through precision grinding such work after hardening, either from the solid or as a finishing operation.

Since Ex-Cell-O introduced the first commercial precision thread grinder in this country five years ago, the airplane engine and other industries have reached exceedingly high standards for threaded parts . . . a new maximum of accuracy through the total elimination of heat-treat distortion.

Wherever high precision is a necessity for threaded work, Ex-Cell-O Precision Thread Grinders are a matter of practical and economical interest. *Use the coupon below to obtain from Ex-Cell-O a new folder on Precision Thread Grinding.*

AUTOMATICS, UNIVERSALS *and* PLAIN PRODUCTION MACHINES Select the exact type for your requirements from Ex-Cell-O's eight styles of Precision Thread Grinders. All simple and flexible in operation.

EX-CELL-O CORPORATION • 1212 OAKMAN BLVD. • DETROIT, MICH.

EX-CELL-O *Precision* MACHINES AND TOOLS

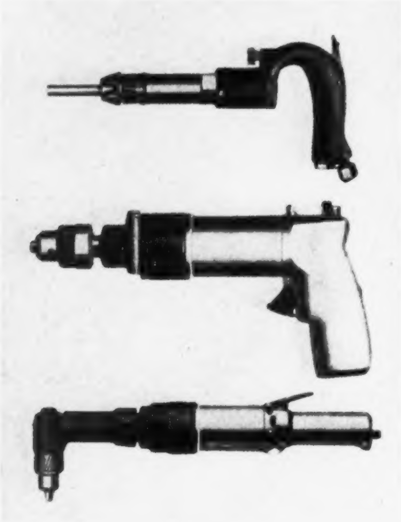
XLO

EX-CELL-O CORPORATION
1212 Oakman Blvd., Detroit, Mich.
Please send me free copy of "Ex-Cell-O Sets the New Standard" (Bulletin No. 48201).

Name ______

Firm ______

Address ______



Portable Air-operated Riveting Hammer and Drills for Use in Aircraft Industry

Ingersoll-Rand Air Tools for Aircraft Industry

A line of light-weight, air-operated riveting hammers, drills, and grinders for use in the aircraft industry has been developed by the Ingersoll-Rand Co., 11 Broadway, New York City. Light-weight riveting hammers of the type shown in the upper view of the illustration are made with either pistol-grip, offset, or push-button handles, and in three sizes with capacities for cold-riveting 1/8, 3/16, and 1/4 inch rivets.

The smallest of these tools is 5 inches in length, and weighs only 4 pounds 12 ounces. The largest size is 9 3/4 inches long, and weighs 5 pounds 3 ounces. A simple power regulator permits easy adjustment of the force and speed of the blow as required for driving either aluminum, Dural, or soft iron rivets.

The "Multi-Vane" air-operated drill with pistol-grip handle, shown in the central view, is made in various types and in a wide range of sizes varying in weight from 1 1/2 to 7 1/2 pounds. In the lower view is shown a "Multi-Vane" drill of the straight-handle type with an angle drilling attachment. 113

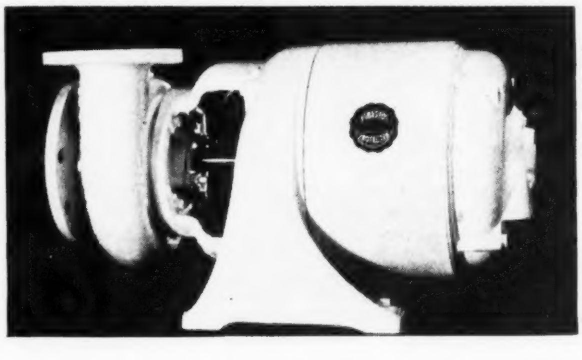
"Ang-Lites" for Industrial Use

Industrial diagnostic lights designated as "Ang-Lites" are being marketed by the Diagnostic Ultra-Lite Co., 170 Broadway, New York City. These lights are expressly designed to bring brilliant illumination at various angles into deeply recessed areas where careful inspection of mechanisms is necessary.

The lights are fabricated from Lucite and are practically unbreakable. They are made in various stock shapes and designs with 3/8-, 1/2-, and 5/8-inch diameters at the threaded ends. With these devices, light can, for instance, be directed around a corner, or through an angle of 180 degrees to light inaccessible places. Both self-contained pocket types and transformer-equipped plug-in units are available. 114

Pyramidal-Base Motor

A pyramidal-base motor has just been developed by U. S. Electrical Motors, Inc., 200 E. Slauson Ave., Los Angeles, Calif. The new design eliminates the possibility of misalignment when a horizontal centrifugal pump is connected to the motor, as shown in the illustration. The mounting is actually an integral part of the motor, and the motor support to which the pump casting is attached carries the load of the pump instead of permitting any of the weight to be imposed on the shaft. Simplicity is achieved in the design shown by reducing the number of parts. No coupling is required, and there is only one shaft. Two large ball bearings take all radial and thrust loads. 115



Pyramidal-base Motor with Pump

Defense Committee of the Machine Tool Industry

The machine tool industry has appointed a Defense Committee of fifteen leading executives, representing important manufacturing plants in the industry located over a broad area geographically. This committee will cooperate with the Government in carrying out the National Defense Plan. The members are as follows:

Chairman, Clayton R. Burt, president, Pratt & Whitney, Division Niles-Bement-Pond Co.; Henry Buker, vice-president, Brown & Sharpe Mfg. Co.; F. H. Chapin, president, National Acme Co.; Howard W. Dunbar, vice-president, Norton Co.; Ralph E. Flanders, president, Jones & Lamson Machine Co.; James Gleason, president, Gleason Works; Charles J. Stilwell, president, Warner & Swasey Co.; Fred V. Geier, president, Cincinnati Milling Machine Co.; Norman D. MacLeod, president, Abrasive Machine Tool Co.; Robert M. Gaylord, president, Ingersoll Milling Machine Co.; Phil Huber, president, Ex-Cell-O Corporation; E. A. Muller, president, King Machine Tool Co.; G. A. Rentschler, president, General Machinery Co.; Joseph L. Trecker, president, Kearney & Trecker Corporation; W. E. Whipp, president, Monarch Machine Tool Co.; J. E. Lovely—ex-officio—president, National Machine Tool Builders' Association, and vice-president and chief engineer of the Jones & Lamson Machine Co.; secretary, Tell Berna, general manager, National Machine Tool Builders' Association.

New Plastics Press

An automatic press for thermosetting plastic materials that employs the transfer method of molding has been developed through the combined efforts of the Shaw Insulator Co., Irvington, N. J., and the Watson Stillman Co., Roselle, N. J. This method of molding is similar to the injection molding of thermoplastics in that the mold is closed empty and the material is then transferred in a plastic state from an auxiliary pressure pot into the cavity of the mold through suitable openings or gates. Use of this unit is expected to be extended to include the injection molding of thermoplastic materials, as well as the compression and transfer molding of the thermosetting group of plastics.

To obtain additional information on equipment described on this page, see lower part of page 212.


Milwaukee ACCURACY . .
IS SAFEGUARDED BY CONSTANT —
✓ TESTING
✓ CHECKING
✓ INSPECTION
The performance-accuracy of Milwaukee Milling Machines is assured by constant testing, checking and inspection. A staff of 75 highly trained technical men are engaged in this important task.
In the world's largest plant devoted exclusively to the manufacture of milling machines there can be no variation from high manufacturing standards.
Kearney & Trecker Corporation
MILWAUKEE, WISCONSIN
K&T
Milwaukee MILLING MACHINES

Molybdenum Steels for High-Speed Locomotive Service

With new fast passenger and freight schedules being established throughout the country, and with more and more trains averaging better than sixty miles an hour on regular runs using existing equipment, it was inevitable that a close re-examination of materials requirements, particularly for locomotives, should be made. Thus it became evident that many materials which were satisfactory when locomotives were running at lower speeds, or on shorter high-speed runs, could not meet the new requirements. It was also found that a reduction of weight in reciprocating parts, such as crossheads, piston-rods, and main- and side-rods, was desirable as a means of lowering the expense of track and road-bed maintenance.

Several railroads have standardized on molybdenum steels for such parts in certain classes of locomotives used for high-speed service, according to the Climax Molybdenum Co., New York City. Both the Texas & Pacific and the Chicago, Milwaukee, St. Paul & Pacific Railroads have standardized on chromium-nickel-molybdenum steel for axles on some classes of motive power used for fast schedules. This steel has the excellent combination of strength, toughness, and resistance to fatigue. Fatigue strength is of primary importance in avoiding progressive fatigue cracks that start just inside the wheel fit and finally cause failure of the axle.

The Texas & Pacific and the Atchison, Topeka & Santa Fe Railroads have standardized on chromium-nickel-molybdenum steel for crankpins in certain classes of locomotives. Resistance and high fatigue strength are essential. In cases where crankpins that have not been liquid-quenched are preferred, a normalized nickel-molybdenum steel is indicated. This is the steel used for crankpins by the Canadian Pacific Railroad.

Chromium-nickel-molybdenum steel is specified for piston-rods by the Texas & Pacific and the Atchison, Topeka & Santa Fe Railroads. The Burlington, Union Pacific, Pennsylvania, and New York Central Railroads also have rods in service made from this steel. Here, again, high fatigue strength is required, as well as toughness and hardness to prevent scoring and to insure uniform wear.

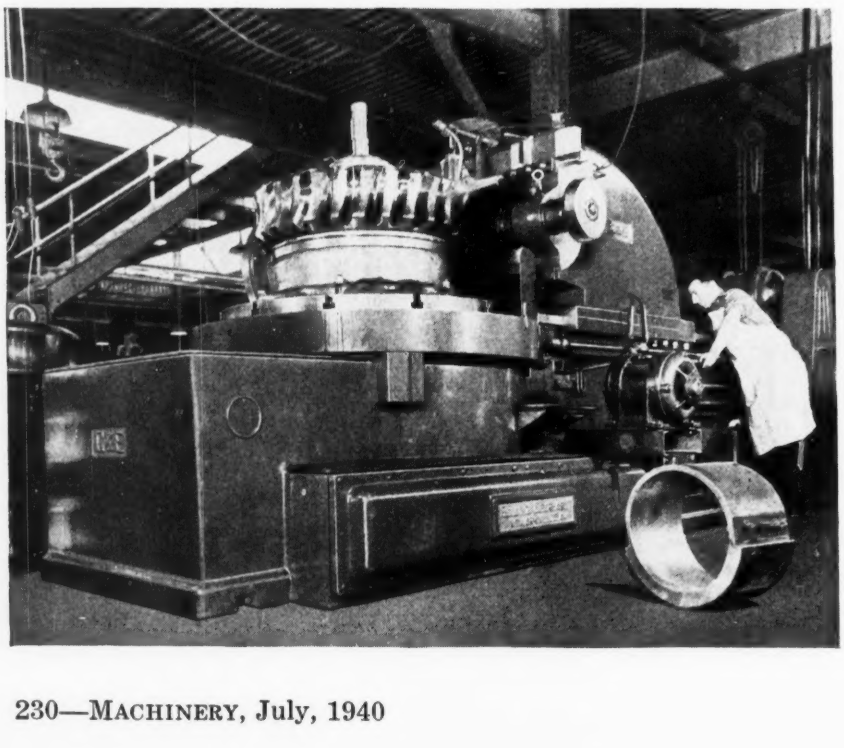
Several railroads have adopted either chromium-nickel-molybdenum or nickel-molybdenum steels for main- and side-rods on locomotives running at high speeds. High yield-tensile ratio, combined with high ultimate and fatigue strengths and adequate toughness, makes these steels well suited to high-speed service conditions. Use of these steels has also resulted in weight savings in the rods ranging up to 50 per cent.

Responsibility Cannot be One-Sided

With a lessening of the friction in labor relations during 1939, industrial management and labor are moving toward a better realization of their mutual interests in a successful national economy. There has been an increasing number of labor difficulties precipitated by the insistence of organized labor on the "closed shop." There is nothing in the Federal law to compel any employe to join a union. And the public is not ready to regard the closed shop as an integral part of collective bargaining. Just as industry must rid itself of every vestige of bad labor relations, lock-outs, and black lists, so organized labor, if it is to earn the public respect necessary to responsible collective bargaining, must clean its own house of the "sit-down," "slow-down," closed shop, and jurisdictional strikes. Acceptance of rights and recognition of responsibilities should go hand in hand.—*Howard Coonley, in his annual report as president of the National Association of Manufacturers*

* * *

Modern lubrication practices as applied to plain bearings are discussed in a booklet entitled "Principles of Plain Bearing Lubrication," which has just been issued by the Tidewater Associated Oil Co., 17 Battery Place, New York City.



A Cone Worm-and-gear Hobber, Built and Installed at the Plant of the Michigan Tool Co., Detroit, Mich., which will Handle Worm-gears up to 90 Inches in Diameter, and Worms up to 20 Inches in Diameter, with 15-inch Diameter Shanks. This Machine can Cut Double Enveloping Worm-gearing Capable of Transmitting 7500 H.P. in a Single Reduction, at 1800 R.P.M.

NEWS OF THE INDUSTRY

California

D. E. SCHELLENBACH, 3245 Sixteenth St., San Francisco, Calif., has been appointed representative of the Michigan Tool Co., Detroit, Mich., to handle the sales of the company's gear finishing and lapping equipment, gear-checking equipment, and metal-cutting tools. Mr. Schellenbach will cover the northern half of California and the four western counties of Nevada. C. HOWARD EDEN, 1031 S. Broadway, Los Angeles, Calif., has been appointed representative in southern California.

VASCOLOY-RAMET CORPORATION, North Chicago, Ill., announces that the CRITERION TOOL SALES, 403 N. Foothill Road, Beverly Hills, Calif., has made arrangements for the manufacture, sale, and service of Vascoloy-Ramet carbide-tipped cutting tools. Both standard and special tantalum-tungsten-carbide tools will be manufactured by the California organization under the supervision of A. J. DENIS, a well-known Detroit tool engineer having long experience with carbide tools.

Illinois, Missouri, and Indiana

GREENLEE FOUNDRY CO., Chicago, Ill., manufacturer of Meehanite castings, recently inaugurated a voluntary instruction course for molders and helpers which meets twice a month. Problems involving sand, shop scrap, and defective castings are discussed and slow-motion moving pictures of iron being poured into molds have been shown. The attendance averages between forty and fifty, and favorable results are noted in improved attitude and workmanship among those taking the course.

WHITING CORPORATION, Harvey, Ill., has purchased the business of the QUICKWORK CO., 400 W. Madison St., Chicago, Ill., manufacturer of the Quickwork line of metal-working machinery, including shears, trimmers, and power hammers. The business will be continued under the name Whiting Corporation, Successor, The Quickwork Co., and will be conducted at the Chicago address, as heretofore.

MAX F. BECKER has been appointed vice-president in charge of sales representatives of the Whiting Corporation, Harvey, Ill. Mr. Becker has been with the Whiting organization since he graduated from Purdue University in 1920, and has held various positions with the company, most recently as sales manager of the Industrial Division.

JOHN SLEZAK has been elected president of the Turner Brass Works, Sycamore, Ill., makers of liquid fuel heating appliances. Mr. Slezak was formerly vice-president and general manager of the company.

W. L. GOURLEY has been elected president of the Lehmann Machine Co., St. Louis, Mo. PAUL LEHMANN, who has been president of the company for many years, has disposed of his interest, but will remain with the company for the next year.

SUPERIOR TOOL & ENGINEERING CO., designer and builder of tools, dies, jigs, fixtures, and special machinery, is now located at 611 W. Willard St., Muncie, Ind. The officers of the company are PAUL E. GROW and WARREN J. HELDENBRAND.

Michigan and Minnesota

HARRY J. SWANSON, vice-president and treasurer of Ottawa Steel Products, Inc., Grand Haven, Mich., who has been in charge of sales and engineering since 1924 when he became a stockholder and director of the company, has sold his interest and resigned. Prior to 1924, Mr. Swanson was an officer and director of the former Detroit Machine Tool Co., pioneer in the centerless grinding field. While associated with that company, he invented and secured a patent on one of the earliest basic developments in centerless grinding. Mr. Swanson is a member of the Society of Automotive Engineers and of the National Association of Cost Accountants. He will take a short rest before making any plans for the future.

HONING EQUIPMENT CORPORATION announces that its business has been moved from 4612 Woodward Ave., Detroit, Mich., to new and larger quarters at 7207 E. McNichols Road, Detroit.

FRED L. LAWRENCE has been appointed Detroit district manager, with offices at 7-251 General Motors Bldg., for the Copperweld Steel Co., Warren, Ohio.

CARL J. HALBORG, previously secretary of the Colonial Broach Co., Detroit, Mich., has been elected president to succeed the late Otto Lundell.

CUTLER-HAMMER, INC., Milwaukee, Wis., manufacturer of electrical equipment, announces that the Minneapolis office and warehouse of the company have been moved to larger quarters at 532 S. 7th St.

New England

SIDNEY A. STEWART has been appointed general manager of the Hamilton Standard Propellers Division of the United Aircraft Corporation, East Hartford, Conn. Mr. Stewart was employed by the Standard Steel Propeller Corporation, a predecessor of the Hamilton organization, in the assembly department in 1929. In 1930, he entered the sales department, and the following year he was made sales manager. Three years ago, he was appointed assistant general manager. Mr. Stewart is a graduate of Princeton University.

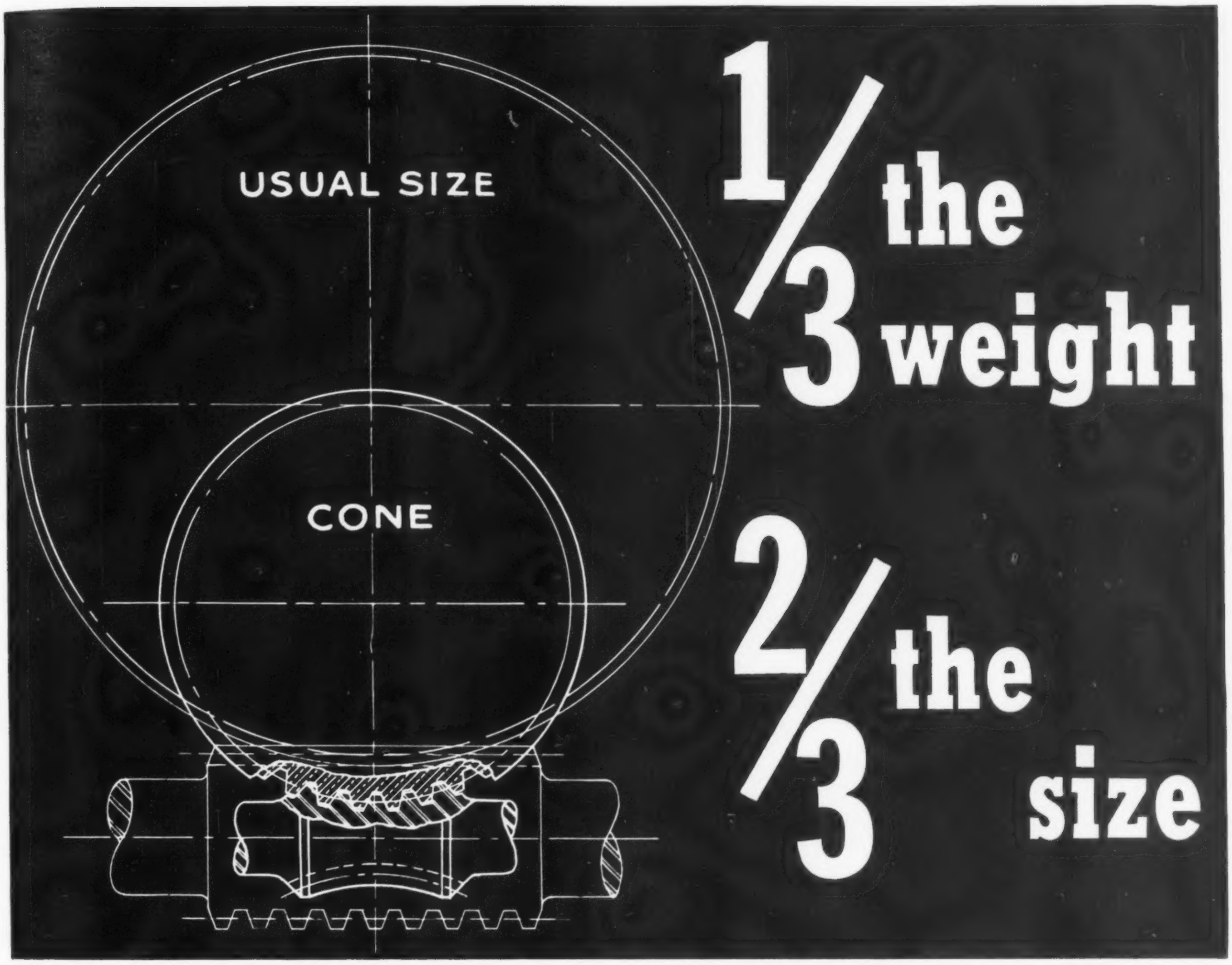
CHARLES J. MCCARTHY has been appointed general manager of the Vought-Sikorsky Aircraft Division of the United Aircraft Corporation, at Stratford, Conn. Mr. McCarthy has been connected with the corporation for fourteen years. For eleven years, he served in the engineering department as executive engineer, chief engineer, and engineering manager; in 1937, he was made assistant general manager of the Division. He is a graduate of the Massachusetts Institute of Technology.

H. MANSFIELD HORNER has been appointed general manager of the Pratt & Whitney Aircraft Division of the United Aircraft Corporation, East Hartford, Conn. Mr. Horner went with the Pratt & Whitney aircraft organization in 1926, one year after it was founded. He has held a number of positions in the production and business departments, and was made assistant general manager in 1938. He is a graduate of the Sheffield Scientific School of Yale University.

JOHN J. BORRUP has been appointed production manager of the Pratt & Whitney Aircraft Division of the United Aircraft Corporation, East Hartford, Conn. G. H. D. MILLER has been made factory manager, and DANIEL JACK assistant factory manager. Mr. Borrup has been associated with the Pratt & Whitney Aircraft Division since its founding in 1925, as superintendent and later as factory manager; Mr. Miller has been assistant factory manager since 1935; and Mr. Jack started to work for the company in 1925.

FREDERICK G. HUGHES, general manager of New Departure Division of General Motors Corporation, Bristol, Conn., manufacturer of ball bearings, was re-elected president of the Manufacturers Association of Hartford County at the annual meeting on June 13.

J. L. DE VOU, JR., and GEORGE L. FREEMAN, of the Norton Co., Worcester, Mass., have been appointed field engineers of the Cleveland and Chicago districts, respectively. GEORGE W. PERSON has been transferred from the Worcester office to the St. Louis territory, for special grinding wheel field service. He will assist the present representative, ARTHUR W. COX.



EVERY POUND of Cone-Drive gearing in an airplane represents a *Net Saving* of over two pounds in total weight.

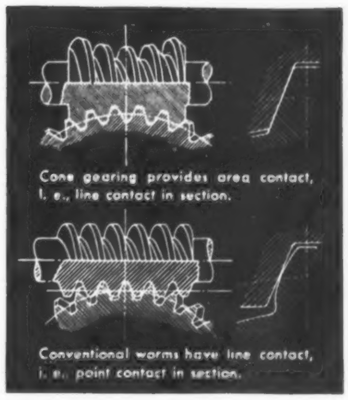
Compared with conventional gearing, Cone-Drive's exclusive double enveloping construction provides continuous area contact on from 3 to 7 teeth (depending on the particular gearset). In addition, the straight-sided tooth form of Cone-Drive gearing insures uniform tooth loading from tip to root with maximum tooth thickness and strength at the root.

The combination of these two exclusive advantages means that 1/3 smaller Cone-Drives do the work of conventional gearing weighing more than 3 times as much—aside from possible weight savings from smaller housings or brackets, design improvements, etc.

In hundreds of airplane installations over a period of 5 years—for retractable landing gears, aileron and flap controls, variable pitch propellors, machine gun elevating drives, synchronizer drives, etc.—there has been not one reported failure of Cone-Drive worm gearing.

OTHER CONE-DRIVE ADVANTAGES—

1. Highest efficiency in the worm gear field.
2. Worm and wheel wear 'in'—not 'out'.
3. Exclusive meshing action squeezes lubricant 'in' instead of 'out'.
4. Positive self-locking action available when desired.
5. Less wear, longer life, due to lower unit pressures.



CURRENT CONE OPERATING RANGES

Ratios . . . Low, 1 to 6; High, 200 to 1.
Speed, Low, 1/15rpm.; High, 30000rpm.
Sizes (C.D.) Low, 5/8 in.; High, 27½ in.

If you do not know the complete technical story of Cone-Drive gearing, may we suggest you write or wire immediately for a copy of Technical manual No. 223b.

CONE WORM GEAR DIVISION **MICHIGAN TOOL COMPANY**
7171 E. McNICHOLS ROAD, DETROIT

Clayton R. Burt Honored by the Pratt & Whitney Sales Organization

CLAYTON R. BURT, president of the Niles-Bement-Pond Co., recently received from the sales organization of Pratt & Whitney, Division Niles-Bement-Pond Co., a unique bronze plaque which is installed over the fireplace in Mr. Burt's office in the new Pratt & Whitney plant in West Hartford, Conn. The plaque is in two parts. The upper half, measuring 12 by 18 inches, shows the new plant in heavy relief with the words "Presented to Clayton R. Burt, President, whose vision and courage made possible this modern plant dedicated to accuracy and devoted to carrying on the tradition of the founders." The lower half carries the 101 names of the Pratt & Whitney sales organization, and also marks 1940 as the eightieth anniversary of the company's founding. The two halves are mounted on a slab of green marble.

JONES & LAMSON MACHINE CO., Springfield, Vt., has added 21,000 square feet of floor space to its plant to provide for an extension of the assembly line, a new shipping room, and a paint shop. A new loading platform, 100 by 20 feet, is also being constructed. Upon the completion of this project, 60,000 square feet of space will have been added to the plant during the last twelve months.

New Jersey

ELASTIC STOP NUT CORPORATION announces the moving of its general offices from Elizabeth, N. J., to its new plant at 2332 Vauxhall Road, Union, N. J., a suburb of Newark. The new plant will be used exclusively for the manufacture of elastic stop self-locking nuts, and has been planned to assure smooth flow of production. It was built by the Austin Co. A feature of interest is the fact that all the steel construction is fastened with bolts and elastic stop-nuts instead of rivets. It is also announced that the Austin, Tex., office of the corporation has been moved to the Merchants and Manufacturers Building.

FRED H. PINKERTON, sales promotion manager of the Mechanical Goods Division of the U. S. Rubber Co., has been elected president of the Industrial Marketers of New Jersey, a chapter of the National Industrial Advertisers Association. Mr. Pinkerton has been active in promoting improved standards for, and increased effectiveness of, industrial advertising.

New York

DEANE MURPHY has been appointed eastern manager of flat rolled carbon steel sales for the Allegheny Ludlum Steel Corporation, with headquarters in the New York office at 60 E. 42nd St. Mr. Murphy has had extensive experience in the steel field, having been with the Allegheny Steel Co. and one of its predecessors for more than twenty years. C. R. MITCHELL, JR., has been made assistant district manager of sales for the New York district office of the corporation. Mr. Mitchell became connected with the Allegheny Steel Co. in 1931. TRUMAN B. BROWN has been appointed manager of Ludlite sales for the corporation, with headquarters at Watervliet, N. Y. Mr. Brown joined the Ludlum Steel Co. in 1934, and has since been employed both in the Chicago office and at Watervliet. LOUIS F. LIPPERT has been appointed manager of Pluramelt sales, with headquarters in the Oliver Bldg., Pittsburgh, Pa.

ERNEST LEFFERT ROBINSON, turbine engineer with the General Electric Co., Schenectady, N. Y., was awarded the honorary degree of Doctor of Science by his alma mater, St. Lawrence University, at the commencement ceremony at Canton, N. Y., on June 10. Mr. Robinson graduated from St. Lawrence University in 1911, and later did graduate work at the Harvard Graduate School of Applied Science, where he was awarded the degree of Master of Civil Engineering in 1914. He entered the employ of the General Electric Co. in 1919, and since that time has worked on steam turbine developments.

W. L. MARTWICK has been elected vice-president in charge of sales of the Foster Wheeler Corporation, 165 Broadway, New York City. Mr. Martwick has been associated with the corporation since its formation in 1927. He was previously connected with the companies which at that time were consolidated into the Foster Wheeler Corporation.

E. H. ANCHORS, formerly branch manager for the Air Reduction Sales Co. at Atlanta, Ga., has been appointed manager of the Oklahoma City district. C. R. HALE has been appointed purchasing agent of the Air Reduction Co., 60 E. 42nd St., New York City, and its subsidiary and affiliated companies, succeeding H. M. DAGGETT who has retired.

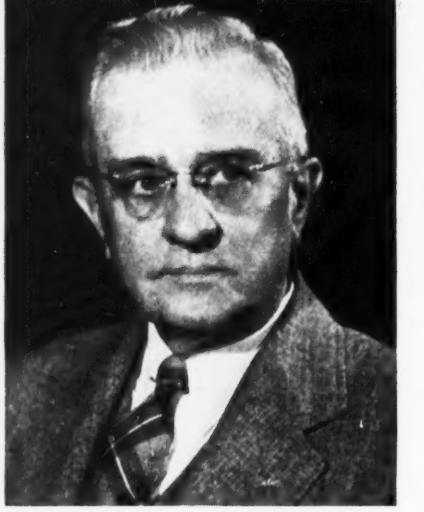
The LINDE AIR PRODUCTS CO., UNIT OF THE UNION CARBIDE AND CARBON CORPORATION, New York City, announces the election of T. D. CARTLEDGE and L. A. BLISS as vice-presidents, and of E. J. HAYDEN as vice-president of the Central Division.

C. K. BRYCE has been elected vice-president of the OXWELD ACETYLENE CO., UNIT OF THE UNION CARBIDE AND CARBON CORPORATION, New York City.

Ohio

WARNER & SWASEY CO., Cleveland, Ohio, is making a second addition to its plant. The 30,000 square foot extension scheduled to be completed early in July is being increased by another 20,000 square foot addition. The basement of the main building of the plant is also extended by 12,000 square feet to provide for additional storage of finished parts.

C. W. SIMPSON, formerly vice-president and works manager of the National Acme Co., Cleveland, Ohio, has been made executive vice-president; R. C. KINLEY, formerly superintendent, has been made vice-president and works manager; and B. H. AYERS, formerly assistant superintendent, has been advanced to the position of superintendent.



William Creider, Machine Tool Sales Manager of Cimatool Co. and Sales Manager of Sheffield Gage Corporation

William Creider has become machine tool sales manager of the Cimatool Co. and sales manager of the Sheffield Gage Corporation, both of Dayton, Ohio. Mr. Creider has had long experience in the metal-working field, first with the Union Switch & Signal Co., Swissvale, Pa., and then, for seventeen years, with the Oilgear Co., Milwaukee, Wis., of which, for the last twelve years, he has been general manager.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has announced plans for a half-million dollar expansion program at the Mansfield, Ohio, plant of the company, where household refrigerators are built, which will increase the production capacity by one-third.

Paul Lindberg, until recently superintendent of rolling mills of the Steel and Tube Division of the Timken Roller Bearing Co., Canton, Ohio, has become connected in a similar capacity with the Steel Division of the Copperweld Steel Co., Warren, Ohio.

Pennsylvania and Virginia

Jessop Steel Co., Washington, Pa., has appointed F. W. Fenner sales representative in the Cleveland district, with headquarters at 1210 E. 55th St., Cleveland, Ohio. Mr. Fenner is a graduate of the Case School of Applied Science. W. H. Raisbeck has been appointed sales representative in the Milwaukee district, with headquarters at Colby-Abbot Bldg., Milwaukee, Wis. Mr. Raisbeck studied mechanical engineering at the University of Iowa, and was with the Anderson Forge & Machine Co. before joining the Jessop Steel Co.

Allegheny Ludlum Steel Corporation, Pittsburgh, Pa., has constructed a new building to house the stainless-steel wire mill at the corporation's Dunkirk plant. This is the fourth time that the stainless-wire capacity of the corporation has been doubled.

J. S. Billingsley was recently appointed manager of the Crucible Steel Co.'s Pittsburgh branch, located in the Oliver Bldg., succeeding M. Stuart Dravo. Mr. Billingsley has been connected with the organization since 1923.

O. P. Robinson has been appointed a member of the Pittsburgh sales engineering staff of Cutler-Hammer, Inc., Milwaukee, Wis., manufacturer of electrical equipment.

Henry Walke Co., Norfolk, Va., has been appointed representative of the Michigan Tool Co., Detroit, Mich., and will handle the sales of the company's gear finishing and lapping equipment, gear-checking equipment, and metal-cutting tools in Washington, D. C., and the eastern half of Virginia.

Texas

A. I. Richardson has been appointed manager of the Allis-Chalmers Mfg. Co.'s district office at Dallas, Tex. He was previously located at the company's district office in Charlotte, N. C.

* * *

Each Westinghouse Employe Works Six Weeks for the Tax Collector

Each employe of the Westinghouse Electric & Mfg. Co. worked six weeks for the tax collector in 1939, according to figures published by the company. The Westinghouse tax bill increased from $2,532,000 in 1930 to $10,390,000 in 1939. These taxes, in 1939, represented $238 for each employe, or an equivalent of six weeks average wages. Or, putting it another way, each week every employe contributed approximately $4 to Federal, state, and local taxes—quite a considerable tax on a man's labor.

* * *

Who Makes Jobs?

A pamphlet containing some interesting facts pertaining to industry's place in our scheme of life has been published by the James F. Lincoln Arc Welding Foundation, P. O. Box 5728, Cleveland, Ohio. This booklet, entitled "We Who Work at Our Industrial Jobs," draws attention to the social and economic significance of industrial progress. The book also contains an outline of the requirements for participation in the $200,000 Industrial Progress Award program sponsored by the Foundation.

A. H. Tuechter—Fifty-Five Years with Cincinnati Bickford Tool Co.

On July 13, August H. Tuechter, president of the Cincinnati Bickford Tool Co., Cincinnati, Ohio, will have completed fifty-five years with the company that he now directs. On July 13, 1885, he began to work for H. Bickford in the latter's machine tool business, which soon afterward was reorganized under the name of the Bickford Drill Co. Mr. Tuechter was made office manager of the company in 1887; and when it was reorganized in 1893 under the name of the Bickford Drill & Tool Co., he became general manager and partner in the business. In 1909, when the company was consolidated with the Cincinnati Machine Tool Co. under the name of the Cincinnati Bickford Tool Co., Mr. Tuechter became its president, a position that he has held ever since.

Mr. Tuechter is recognized as one of the leaders in the machine tool industry.

August H. Tuechter

He was president of the National Machine Tool Builders' Association from 1920 to 1922, and has always taken a prominent part in its affairs. He has an unusually large number of friends both inside and outside of the machine tool industry.

* * *

A compilation of group life insurance statistics as of May 1, 1939, shows that the average age of the employes of the subsidiary companies of the U. S. Steel Corporation is 40.64 years. The statistics further show that nearly one-half, or 49.5 per cent, of the employes are over forty years of age.

OBITUARIES

Otto H. Falk

General Otto H. Falk, chairman of the board of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., died in Milwaukee on May 21 at the age of seventy-four

Otto H. Falk

years. He was taken ill last fall with a heart ailment and had been confined to bed since November.

After having devoted the earlier part of his life to a successful military career, General Falk turned his attention to industry, and became one of the well-known leaders in that field. He was made president, and later chairman of the board, of the Allis-Chalmers Mfg. Co. He also served as a director of the First Wisconsin National Bank, as well as an officer and director in many corporations.

General Falk was born in Milwaukee in 1865. He was educated at Northwestern College and at the Allen Military Academy of Chicago. After having distinguished himself in the military field, and having been retired from the National Guard in 1911 with the rank of brigadier general, he became receiver of the Allis-Chalmers Co. in 1912 and did most conspicuous work in reorganizing this company into the present Allis-Chalmers Mfg. Co., of which he was elected president immediately upon its reorganization.

General Falk was also active in many civic organizations. He was a regent of the Marquette University. Many times he was asked to run for high public office which, however, he always declined.

General Falk's military and industrial activities were both characterized by untiring energy and ability. He was highly respected and admired by all who knew him.

Harry T. McDonald, research engineer for the Caterpillar Tractor Co., Peoria, Ill., died suddenly at his home in Peoria on June 3, following a heart attack. Mr. McDonald was born in Peoria in 1892 and graduated from the Bradley Polytechnic Institute of that city. He had been in the employ of the Caterpillar company and its predecessor, the Holt Mfg. Co., for twenty-two years, having joined the Holt company as a draftsman. During the World War, he was stationed at Camp Taylor in Montgomery, Ala. He was a member of the Officers' Training Corps, the United States Ordnance Advisory Board, and of the Society of Automotive Engineers.

Mr. McDonald was recognized nationally as an authority on track type tractor design, and his advice was eagerly sought and generously given to government departments in connection with the use and application of track type machines. Mr. McDonald is survived by his wife and two sons.

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Industrial Skin Protection

The protection of the hands of industrial workers against contamination by lubricating oils, cutting compounds, acids, etc., has always presented a difficult problem. The Milburn Co., 905 Henry St., Detroit, Mich., has brought out three different kinds of creams and ointments, developed on the principle of applying an extra layer or coating to the skin, which coating is insoluble in the specific chemical or oil against which the hands are to be protected. These protective applications are known by the trade name "Ply." One type is intended for protection against dirty grease and oil, paint, asphalt, tar, etc.; another is used for protection against petroleum products, cooling lubricants, and cutting compounds; and the third for protection against acids.

* * *

The engineer brings to the problem [of production] a particular kind of clear thinking that seems to be rare among politicians. The engineer cannot help realizing that if we are all to consume more and have more to enjoy on a per capita basis, we must somehow contrive to produce more, also on a per capita basis. In other words, the engineer starts with a fundamental equation thus expressed: Average standard of living equals total production divided by total population. He instinctively looks askance at any proposal to *increase* the value of the fraction by *decreasing* the numerator.—*Harvey N. Davis, president, Stevens Institute of Technology*

COMING EVENTS

September 3-6 — Fall meeting of the American Society of Mechanical Engineers in Spokane, Wash. Further information may be obtained by addressing C. E. Davies, secretary, 29 W. 39th St., New York City.

September 18-20 — Eighteenth annual conference of the National Industrial Advertisers Association to be held at the Hotel Statler, Detroit, Mich. For further information, address National Industrial Advertisers Association, Inc., 100 E. Ohio St., Chicago, Ill.

October 7-11—National Safety Congress and Exposition to be held at the Stevens Hotel, Chicago, Ill., under the auspices of the National Safety Council, 20 N. Wacker Drive, Chicago, Ill.

October 8-12 — Southern Power and Engineering Show in the Armory Auditorium, Charlotte, N. C. For further information, address Junius M. Smith, vice-president, Southern Power and Engineering Show, Inc., P. O. Box 1225, Charlotte, N. C.

October 21-25 — National Metal Exposition, to be held at Cleveland, Ohio, under the auspices of the American Society for Metals. W. H. Eisenman, secretary, 7301 Euclid Ave., Cleveland.

December 2-5—Annual meeting of the American Society of Mechanical Engineers in New York City. For further information, address C. E. Davies, secretary, 29 W. 39th St., New York City.

December 2-7 — Fourteenth National Exposition of Power and Mechanical Engineering to be held at the Grand Central Palace, New York City. For further information, address International Exposition Co., Grand Central Palace, New York City.

March 24-29, 1941—Machine and Tool Progress Exhibition at Convention Hall, Detroit, Mich., under the auspices of the American Society of Tool Engineers, 2567 W. Grand Blvd., Detroit, Mich.

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Plastics Competition

The fifth annual Modern Plastics Competition has been announced by the *Modern Plastics Magazine*, 122 E. 42nd St., New York City. Any product designed or placed on the market since September 1, 1939, in which any sort of plastic material is a component part is eligible for entry. All entries must be received by August 15.